those alternatives that are practical or feasible from a common sense, technical, and economic standpoint. The range of reasonable alternatives is, therefore, limited to continued LLNL operations. NNSA mission line assignments to LLNL define the Administration's purpose and need for action, as discussed in Chapter 1 of the LLNL SW/SPEIS.

NNSA carefully considered public input and comments received during the pre-scoping and scoping processes. No additional alternatives were considered in detail in the LLNL SW/SPEIS because the range of alternatives were adequate for assessing impacts associated with the Administration's purpose and need.

B.4 DESCRIPTION OF THE AFFECTED ENVIRONMENT FOR WASTE MANAGEMENT

B.4.1 Environmental Setting/Existing Conditions

Understanding the environmental setting and existing conditions is necessary for understanding potential impacts from waste operations at LLNL. This section describes the existing conditions of the physical and natural environment for LLNL waste management facilities and operations, and the relationship of people with that environment. Descriptions of the affected environment provide a framework for understanding the direct, indirect, and cumulative effects of each of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. The discussion is categorized by resource area to ensure that all relevant issues are included. This section is divided into the following 16 resource areas and topic groupings that support the impact assessment discussed in Section B.5:

- Land Use and Applicable Plans
- Socioeconomic Characteristics and Environmental Justice
- Community Services and Recreation
- Prehistoric and Historic Cultural Resources
- Aesthetic and Scenic Resources
- Meteorology
- Geological Resources and Hazards (including soils)
- Ecology
- Air Quality
- Water Resources and Hydrology
- Noise
- Minerals
- Traffic and Transportation

- Materials and Waste Management
- Utilities and Energy
- Worker Safety and Human Health

The information in this appendix comes primarily from the comprehensive environmental monitoring and surveillance programs that DOE maintains at LLNL and web-based information. Data for 1992 through 2002 are also included where necessary to present trends. Other relevant information is summarized and incorporated by reference.

Detailed discussions of each environmental resource in the overall affected environment for LLNL is the same as would be discussed for RHWM facilities. Because overall LLNL operations and RHWM operations are interdependent and interconnected, the affected environment and impacts under the various alternatives may be discussed collectively (site-wide basis). As appropriate, each resource and topic area includes a discussion of the area that may be affected by RHWM activities. The discussion establishes the scope of analysis and in general focuses the appendix on relevant information specific to RHWM facilities. Because resources and topic areas are often interrelated, one section may refer to another.

Potential releases of materials from LLNL can reach the environment and people in a number of ways. The routes that materials follow from LLNL to reach the environment and subsequently people are called transport and exposure pathways. LLNL conducts environmental monitoring to determine whether radioactive and nonradioactive materials and wastes were released into the environment. Environmental monitoring also assesses the potential for people to encounter these materials and wastes by any route of exposure. Sampled media include air, vegetation, groundwater, stormwater runoff, and wastewater discharge. LLNL publishes an annual site environmental report that contains details on these sampling programs (SNL 1997, LLNL 1998b, LLNL 1999c, LLNL 2000g, LLNL 2001v, LLNL 2002cc, LLNL 2003l).

Pursuant to the management of hazardous, radioactive, mixed, and medical wastes generated, RHWM programs implement site-wide plans and operating practices to comply with regulatory requirements. Inspections and findings of the Livermore Site and Site 300 by external agencies in 2001 are listed in Table B.4.1–1. A summary of permitting activities is presented in Table B.4.1–2. Table B.4.1–3 contains summaries of major laws, regulations, and orders relevant to LLNL RHWM facilities.

TABLE B.4.1–1.—*Inspections and Findings of the Livermore Site and Site 300 by External Agencies in 2001*

Medium	Description	Agency	Date	Finding
Livermore Site				
Sanitary sewer	Annual compliance sampling	LWRP	October 2 October 8, 9	No violations
	Categorical sampling		October 15 October 31	No violations
Waste	Hazardous waste facilities	DTSC	June 20–22	Received an inspection report and final SOV on 11/6/01 with two minor violations and one violation categorized as "other violation." All violations were resolved by LLNL before the final SOV was received on 11/6/01.
	Medical waste	ACDEH	September 25	No violations
Storage tanks	Compliance with underground storage tank upgrade requirements and operating permits.	ACHCS	June 26 August 21 September 4, 17 October 17	No violations
HW transportation	Biennial terminal inspection	CHP	January 5	Three minor deficiencies (short mud flaps, two loose bolts) corrected during inspection.
Site 300				
Waste	Permitted hazardous waste facilities (EWTF, EWSF, B883 CSA), waste accumulation area B883 north, and generator areas.	DTSC	May 16–18	Three violations were issued. One violation was issued on 5/18 and two additional violations were issued in an amended inspection report which LLNL received on 8/15. All violations have been corrected.
			August 16, 17	No violations

Source: LLNL 2002cc.
ACDEH = Alameda County Department of Environmental Health; ACHCS = Alameda County Health Care Services; CHP = California Highway Patrol; CSA = Container Storage Area; DTSC = Department of Toxic Substances and Control; EWSF = Explosives Waste Storage Facility; EWTF = Explosives Waste Treatment Facility; HW = Hazardous Waste; LWRP = Livermore Water Reclamation Plant; SOV = Summary of Violations.

TABLE B.4.1–2.—*Summary of Permits Active in 2001 and 2002*

Type of Permit	Livermore Site	Site 300
Hazardous waste	EPA ID No. CA2890012584. Authorization to mix resin in Unit CE231-1 under conditional exemption tiered permitting. Final closure plan submitted to DTSC for the Building 419 interim status unit (February 2001). Authorizations to construct the permitted units of Building 280, Building 695, and additions to Building 693. Authorization under hazardous waste permit to operate 18 waste storage units and 14 waste treatment units. Continued authorization to operate seven waste storage units and eight waste treatment units under interim status. Final closure plans submitted to DTSC for the Building 233 CSU and Building 514 interim status units (May 2000). Notified DTSC on 3/31/01 that LLNL will not modify and operate Building 280 as a permitted unit as described in our hazardous waste facility permit.	EPA ID No. CA2890090002. Part B Permit—Container Storage Area (Building 883) and Explosives Waste Storage Facility (issued May 23, 1996). Part B Permit—Explosives Waste Treatment Facility (issued October 9, 1997). Docket HWCA 92/93-031. Closure and Post-Closure Plans for Landfill Pit 6 and the Building 829 Open Burn Facility. Post-Closure Permit Application submitted for Building 829 Open Burn Facility (September 2000)[a]. Prepared a Notice of Deficiency (NOD) response document to be submitted to DTSC in February 2002.
Medical waste	One permit for large quantity medical waste generation and treatment covering the biology and biotechnology research program, Health Services Department, Forensic Science Center, Medical Photonics Lab, and Tissue Culture Lab.	Limited Quantity Hauling Exemption for small quantity medical waste generator.
Sanitary sewer	Discharge Permit No. 1250 (01/02) for discharges of wastewater to the sanitary sewer. Permit 1510G (01) for discharges of sewerable groundwater from CERCLA restoration activities.	
Storage tanks	Eight operating permits covering 11 underground petroleum product and hazardous waste storage tanks: 111-D1U2 Permit No. 6480; 113-D1U2 Permit No. 6482; 152-D1U2 Permit No. 6496; 271-D2U1 Permit No. 6501; 321-D1U2 Permit No. 6491; 322-R2U2 Permit No. 6504; 365-D1U2 Permit No. 6492; and 611-D1U1, 611-G1U1, 611-G2U1, and 611-O1U1 Permit No. 6505.	One operating permit covering five underground petroleum product tanks assigned individual permit numbers: 871-D1U2 Permit No. 008013; 875-D1U2 Permit No. 006549; 879-D1U1 Permit No. 006785; 879-G3U1 Permit No. 007967; and 882-D1U1 Permit No. 006530

Source: LLNL 2002cc, LLNL 2003l.

[a] On February 20, 2003, the DTSC issued a Post-Closure Permit for Building 829.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; DTSC = Department of Toxic Substances and Control; HWCA = Hazardous Waste California.

TABLE B.4.1–3.—*Summary Of Major Laws, Regulations, and Orders*

Laws, Regulations, and Orders	Description
Solid Waste Disposal Act of 1976 (42 U.S.C. §6902)	This Act regulates the management of solid waste. Solid waste is broadly defined to include any garbage, refuse, sludge, or other discarded material including solid, liquid, semisolid, or contained gaseous materials resulting from requirements and controls for transport, test procedures, and administrative requirements. Schedules include industrial, commercial, mining, or agricultural activities. Specifically excluded as solid waste is source, special nuclear, or by product material as defined by the *Atomic Energy Act*.
Resource Conservation and Recovery Act of 1976 (42 U.S.C. §6901, et seq.)	This Act amends the *Solid Waste Disposal Act* and establishes requirements and procedures for the management of hazardous wastes. As amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA), RCRA defines hazardous wastes that are subject to regulation and sets standards for generation, treatment, storage, and disposal facilities. The HSWA emphasize reducing the volume and toxicity of hazardous waste. They also establish permitting and corrective action requirements for RCRA-regulated facilities. RCRA was also amended by the *Federal Facilities Compliance Act* (FFCA) in 1992. It requires the EPA, or a state with delegated authority, to issue an order for compliance. A Federal facilities compliance order was issued by the California EPA, requiring the DOE and LLNL to comply with the FFCA. Compliance with the order is achieved through Site Treatment Plans prepared by DOE.
Underground Storage Tanks (42 U.S.C. §6901, Subtitle I)	Underground storage tanks are regulated as a separate program under RCRA, which establishes regulatory requirements for underground storage tanks containing hazardous or petroleum materials. California EPA has been delegated authority for regulating LLNL.
Federal Facility Compliance Act of 1992 (42 U.S.C. §6961)	This 1992 Act waives sovereign immunity from fines and penalties for RCRA violations at Federal facilities. However, it postponed the waiver for three years for storage prohibition violations with regard to land disposal restrictions for the DOE's mixed wastes. It required DOE to prepare plans for developing the required treatment capacity for each site at which it stores or generates mixed waste. The state or EPA must approve each plan (referred to as a Site Treatment Plan) after consultation with other affected states, consideration of public comments, and issuance of an order by the regulatory agency requiring compliance with the plan. The Act further provides that DOE will not be subject to fines and penalties for storage prohibition violations for mixed waste as long as it complies with an existing agreement, order, or permit. The FFCA requires that Site Treatment Plans contain schedules for developing treatment capacity for mixed waste for which identified technologies exist. The DOE must provide schedules for identifying and developing technologies for mixed waste without an identified existing treatment technology. A Federal Facility Compliance Order was signed in 1997 to address treatment and disposal of mixed waste, as well as characterization and disposal of TRU waste.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as Amended (42 U.S.C. §9601, et seq.)	This Act, commonly referred to as the CERCLA, or Superfund, establishes liability standards and governmental response authorization to address the release of a hazardous substance or contaminant into the environment. The EPA is the regulating authority for the Act. CERCLA was amended by the *Superfund Amendments and Restoration Act* (SARA) in 1986. SARA Title III establishes additional requirements for emergency planning and reporting of hazardous substance releases. These requirements are also known as the *Emergency Planning and Community Right-to-Know Act* (EPCRA), which, due to its unique requirements is discussed separately below. SARA also created liability for damages to or loss of natural resources resulting from releases into the environment and required the designation of Federal and state officials to act as public trustees for natural resources. LLNL is subject to, and required to report releases to the environment under the notification requirements in 40 CFR Part 302 (Designation, Reportable Quantities, and Notification) and EPCRA, as applicable. Pursuant to CERCLA Section 120, DOE signed a Federal Facility Agreement for LLNL in 1989 and Site 300 in 1992.

TABLE B.4.1–3.—*Summary of Major Laws, Regulations, and Orders (continued)*

Laws, Regulations, and Orders	Description
Hazardous Waste Control Act (California Health and Safety Code § 25100 et seq.)	This Act is the state authorization to implement the state hazardous waste program pursuant of RCRA.
Hazardous Waste Reduction Act (California Health and Safety Code § 25244.12-24)	This Act expands the State of California hazardous waste source reduction activities to accelerate reduction in hazardous waste generation.
Pollution Prevention Act of 1990 (42 U.S.C. §13101)	This Act sets the national policy for waste management and pollution control that focuses first on source reduction, followed sequentially by environmentally safe recycling, treatment, and disposal. In response, the DOE committed to voluntary participation in EPA's 33/50 Pollution Prevention Program, as set forth in Section 313 of SARA.
Toxic Substances Control Act of 1977 (15 U.S.C. §2601, et seq.)	This Act, unlike other statutes that regulate chemicals and their risk after they have been introduced into the environment, was intended to require testing and risk assessment before a chemical is introduced into commerce. It also establishes record keeping and reporting requirements for new information regarding adverse health and environmental effects of chemicals. The Act governs the manufacture, use, storage, handling, and disposal of PCBs; sets standards for cleaning up PCB spills, and establishes standards and requirements for asbestos identification and abatement in schools. It is administered by the EPA. Because LLNL's R&D activities are not related to the manufacture of new chemicals, PCBs are LLNL's main concern under the Act. Activities at LLNL that involve PCBs include, but are not limited to, management and use of authorized PCB-containing equipment, such as transformers and capacitors, management and disposal of substances containing PCBs (dielectric fluids, contaminated solvents, oils, waste oils, heat transfer fluids, hydraulic fluids, paints, slurries, dredge spoils, and soils), and management and disposal of materials or equipment contaminated with PCBs as a result of spills. At LLNL, PCB-contaminated wastes are transported offsite for treatment and disposal unless they also have a radioactive component. Nonradioactive wastes containing PCBs are disposed of at an offsite facility that has been approved by the EPA for such disposal (provided that strict requirements are met with respect to notification, reporting, record-keeping, operating conditions, environmental monitoring, packaging, and types of wastes disposed). Radioactive PCB waste, typically known as TRU mixed waste or mixed waste, is currently stored at one of LLNL's hazardous waste storage facilities until the Waste Isolation Pilot Project, or other approved facility, accepts this waste for final disposal. LLNL conducts asbestos abatement projects in accordance with Occupational Health and Safety Administration (OSHA) requirements (29 CFR Part 1926), applicable requirements of the *Clean Air Act*, and the California Solid Waste Management Regulations.
Atomic Energy Act of 1954	This Act, makes the Federal government responsible for regulatory control of the production, possession, and use of three types of radioactive material: source, special nuclear, and byproduct (includes waste). Regulations promulgated by the U.S. Nuclear Regulatory Commission (NRC) under the *Atomic Energy Act* establish standards for the management of these radioactive materials (including waste).
40 CFR Part 260	The implementing regulations established by EPA governing hazardous wastes (RCRA).

TABLE B.4.1–3.—*Summary of Major Laws, Regulations, and Orders (continued)*

Laws, Regulations, and Orders	Description
Title 22 CCR Division 4.5	The implementing regulations established by California EPA for management of hazardous waste.
DOE Order 435.1, Radioactive Waste Management	DOE Order 435.1 establishes the policies, guidelines, and minimum requirements by which the DOE and its contractors manage radioactive waste, mixed waste, and contaminated facilities. This order establishes DOE policy that radioactive and mixed wastes be managed in a manner that ensures protection of the health and safety of the public, the DOE, contractor employees, and the environment. In addition, the generation, treatment, storage, transportation, and disposal of radioactive wastes, and the other pollutants or hazardous substances they contain, must be accomplished in a manner that minimizes the generation of such wastes across program office functions and complies with all applicable Federal, state, and local environmental, safety, and health laws and regulations and DOE requirements.

Source: LLNL 2002cc.

B.4.2 Land Uses and Applicable Plans

B.4.2.1 *Existing Land Uses*

B.4.2.1.1 *Livermore Site*

Onsite Land Uses

Onsite land uses at the 821-acre Livermore Site include offices, laboratory buildings, support facilities (e.g., cafeterias, storage areas, maintenance yards, and a fire station), roadways, parking areas, and landscaping. The site also includes internal utility and communication networks. See Chapter 2 and Appendix A for detailed descriptions of onsite land uses, facilities, and major programs. A 500-foot wide security buffer zone lies along the northern and western borders of the Livermore Site.

Surrounding Land Uses

The Livermore Site is bordered on the east by Greenville Road. The property east of Greenville Road is agricultural with a few scattered rural residences and is used primarily for grazing. A Western Area Power Administration electrical substation is on the southeast corner of Greenville Road and Patterson Pass Road. The South Bay Aqueduct, a branch of the California Aqueduct, traverses the land east of the Livermore Site in a north-south direction. The Patterson Reservoir and filtration plant for the South Bay Aqueduct are northeast of the Livermore Site along Patterson Pass Road.

Patterson Pass Road runs along the northern boundary of the Livermore Site. Across Patterson Pass Road to the north is a light-industrial park. This area also includes a Pacific Gas and Electric construction training center. Several new industrial park complexes have been completed in recent years. A Union Pacific Railroad line runs in an east-west direction along the northern boundary of the industrial park. Land uses farther north include vacant land, industrial uses, a Union Pacific Railroad line, and Interstate 580 (I-580). Land northeast of the site is agricultural and used primarily for grazing. Wind turbines are installed on the hills of the Altamont Pass, northeast of the site.

On the west, the Livermore Site is bordered by Vasco Road. A low-density, single-family residential subdivision begins at the southwest corner of Patterson Pass Road and Vasco Road and extends south and west. A new housing development of attached single-family residences is currently being completed directly west of the site (north of East Avenue). Medium-density residential areas, mainly apartment complexes, exist on the west side of this new development approximately 2,000 feet west of Vasco Road.

To the south, the Livermore Site is bordered by East Avenue. South of East Avenue is the Sandia National Laboratories, California (SNL/CA), which has land uses very similar to those in LLNL. The primary land uses to the east and west of SNL/CA are rural residential and agricultural (mainly grazing). A K-8 school, The Stivers Academy, is located to the west of SNL/CA on the east side of Vasco Road, between East Avenue and Tesla Road. Public access to the section of East Avenue common to the Livermore Site is administratively controlled beginning in 2003 (DOE 2002h). There is a small light-industrial park on the southwest corner of East Avenue and Vasco Road. South of this industrial park, a new single-family housing development is being built.

B.4.2.1.2 *Site 300*

Onsite Land Uses

Site 300 is on approximately 7,000 acres of largely undeveloped land. Site 300 is primarily a nonnuclear high explosives and other nonnuclear weapons component test facility. The site has three remote high explosive testing facilities supported by a chemistry processing area, a weapons test area, maintenance facilities, and a General Services Area (GSA) at the site entrance. One hundred and sixty acres have been developed as the "*Amsinckia grandiflora* Reserve" to protect this species' natural habitat.

Surrounding Land Uses

The majority of existing land uses surrounding Site 300 are agricultural, primarily for the grazing of cattle and sheep. Two other smaller, privately operated defense-related research and testing facilities are located near Site 300. The property east of and adjacent to Site 300 is now owned by Fireworks America and is currently being used to store pyrotechnics. A portion of the property is leased to Reynolds Initiator Systems, Inc., and is used to manufacture initiators (agents which cause a chemical reaction to commence). A facility, operated by SRI International, that conducts high explosives tests, is approximately 0.6 mile south of Site 300.

Corral Hollow Road borders Site 300 on the south. South of the western portion of Site 300 across Corral Hollow Road is the Carnegie State Vehicular Recreation Area, covering approximately 5,000 acres and operated by the California Department of Parks and Recreation Off-Highway Motor Vehicle Recreation Division for the exclusive use of off-highway vehicles. The nearest urban area is the city of Tracy, approximately 2 miles northeast of Site 300. Rural residences are located along Corral Hollow Road, west of Site 300 and the Carnegie State Vehicular Recreation Area. Power-generating wind turbines occupy the land northwest of the site.

B.4.2.2 *Land Use Plans and Programs*

Livermore Site

The city of Livermore and Alameda County do not have planning jurisdiction over the Livermore Site because it is a Federal facility owned by DOE. However, for purposes of providing a complete description to the public and decision makers of the existing and potentially affected environment, local land use planning in the vicinity of the Livermore Site is presented in this section.

Alameda County General Plan: East County Area Plan

The East County Area Plan replaces the Livermore-Amador Valley Planning Unit General Plan. The East County Area Plan was adopted by the Alameda County Board of Supervisors on May 5, 1994, and was amended most recently in May 2000 (Alameda County 1994). The Livermore Site lies within Alameda County and most of it is zoned "M-P" for industrial-park use. The Alameda County Zoning Code specifies "laboratory, including research, commercial, testing, developmental, experimental or other types" as a permitted use within the M-P Zone. The remaining portions of the Livermore Site lie within the city of Livermore and are not subject to county zoning.

The Livermore Site is designated as being outside the urban growth area for the city of Livermore. Areas north and west of the Livermore Site are designated as lands within the Livermore city limits and are within the urban growth boundary. The area to the south, including SNL/CA, is also within the urban growth boundary. Policy 144 of the East County Plan states that "The County shall ensure that all new uses approved near the Lawrence Livermore National Laboratories in East Livermore are compatible with Laboratory operations." The county's land use designations in and near the Livermore Site include industrial, large parcel agricultural, residential, and other open space.

The portion of the Livermore Site within Alameda County is designated industrial. SNL/CA south of East Avenue is also designated industrial. The areas adjacent to SNL/CA on the east, west, and south are designated limited agriculture. The areas directly east of LLNL, across Greenville Road is designated large parcel agricultural. To the west are residential areas.

There are other designated open space areas in east Alameda County in the general vicinity of the Livermore Site: one is 4 miles south and the other 3 miles north of the Livermore Site. Approximately 3 miles northeast of the Livermore Site is a Wind Resource Area. Running northeast to southwest approximately 100 yards west of the site is a canal, the South Bay Aqueduct, which is designated as Water Management.

Livermore Community General Plan, 1976–2000

The Livermore Community General Plan, 1976–2000, was adopted by the Livermore City Council on March 8, 1976, and updated in August 1998 (City of Livermore 1975). Most of the Livermore Site is designated low intensity industrial, with the northern 500-foot perimeter area designated high intensity industrial. The Livermore Community General Plan designates the areas north of the Livermore Site as high intensity industrial. Areas west of the Livermore Site are designated as urban low-medium residential to urban high residential. Small areas within the

residential areas are designated as open space parks, which include parks, trailways, recreation corridors, and protected areas. Areas south and east of the Livermore Site and SNL/CA are designated low-intensity industrial and the area farther west up to Greenville Road is designated as limited agricultural with a 20-acre minimum lot requirement.

City of Livermore Zoning

The northern perimeter area of the Livermore Site is zoned I-3 for heavy industrial use, and the western perimeter area is zoned I-2 for light industrial use (City of Livermore 2002a). These are the areas within the city of Livermore boundaries. The Livermore Zoning Ordinance provides for manufacturing, warehousing and distribution facilities, research and development facilities; professional and administrative offices, restaurants, wholesale certified recycler and recycle processor, and off-street parking as principal permitted uses within the I-2 zones. In addition to those uses in the I-2 zone, the I-3 zone permits contractor storage yards, truck terminals, or other open storage uses and recycle processor uses (City of Livermore 2002b).

The surrounding areas north of the Livermore Site are designated I-3. Areas west of the Livermore Site are designated as PD for planned development, PDR for planned development residential, RS-3 for residential use with a maximum density of three dwelling units per acre, RG-10 for suburban multiple-residential use (approximately 10 dwelling units per acre), RS-5 for residential use with a maximum density of five dwelling units per acre, and RL-6 for low-density residential with a minimum lot size of 6,000 square feet.

Site 300

Most of Site 300 is in San Joaquin County, with a small portion in Alameda County. The city of Tracy is located approximately 2 miles northeast of the site. Planning programs of these three government entities are addressed below to provide a basis for evaluating Site 300's compatibility with future surrounding land uses. San Joaquin and Alameda Counties and the city of Tracy do not have planning jurisdiction over Site 300 because it is a Federal facility, owned by DOE.

San Joaquin County General Plan

The San Joaquin County General Plan was adopted by the San Joaquin County Board of Supervisors on June 29, 1992 (San Joaquin County 1992). The land use/circulation element of the General Plan contains goals, objectives, and principles for land use development and circulation and transportation within San Joaquin County.

The portion of Site 300 in San Joaquin County is designated public and quasi-public. Areas north and east of Site 300 are designated general agricultural. Areas south of Site 300, along Corral Hollow Road, are designated as recreation and conservation areas. Areas to the north and west are designated as general agriculture.

San Joaquin County Zoning

The portion of Site 300 in San Joaquin County is zoned AG-160 for general agriculture with a 160-acre minimum parcel size. The agricultural zone was established to preserve agricultural lands for the continuation of commercial agricultural enterprises. In addition, hazardous

industrial operations using explosives are permitted within the agricultural zone, subject to use permits (San Joaquin County 1992).

Alameda County General Plan: East County Area Plan

The East County Area Plan designates this portion of Site 300 as major public. The East County Area Plan Policy 138 states that "the County shall allow development and expansion of major public facilities (e.g., hospitals, research facilities, landfill sites, jails, etc.) in appropriate locations inside and outside the Urban Growth Boundary consistent with the policies and Land Use Diagram of the East County Area Plan."

Alameda County Zoning

The portion of Site 300 in Alameda County is zoned A for agricultural use. The Alameda County Ordinance Code specifies "remote testing facilities" as a conditional use within the A district, subject to approval by the zoning administrator for Alameda County (Sections 8-94.0 and 8-25.0).

City of Tracy General Plan

Site 300 is approximately 2 miles southwest of the city of Tracy. The Site 300 area is designated on the city of Tracy Community Areas Map as Federal Reserve/Open Space (FR/O) (City of Tracy 1993). Site 300 borders the city of Tracy's sphere of influence, which is designated as the Tracy Hills area. The Tracy Hills planning area includes both Tracy sphere of influence lands in San Joaquin County and an area southwest of I-580 recently annexed by the city of Tracy. The area adjacent to Site 300 in Tracy's sphere of influence has been designated Open Space Habitat. The Tracy Hills area within the city limits of Tracy has been zoned as low and medium-density residential. A residential development project is proposed for the Tracy Hills area.

B.4.3 Socioeconomic Characteristics and Environmental Justice

B.4.3.1 *Socioeconomic Characteristics*

Employment characteristics of the communities in the region surrounding the Livermore Site and Site 300 are presented in this section by relevant county and city. Approximately 93 percent of the LLNL workforce reside within Alameda, San Joaquin, Contra Costa, and Stanislaus counties. As of September 2002, approximately 10,600 persons comprised the workforce at LLNL (LLNL 2002dm). This appendix bounds the analysis by estimating the total waste management work force at 150 people.

Alameda County

The California Employment Development Department (EDD) reported a 2001 total employed labor force of 721,000 persons in Alameda County (Table B.4.3.1–1). This represented a 13.3 percent increase over the 1991 annual average of 636,300. The average annual unemployment rate for 2001 was 4.5 percent (33,900 persons), which was lower than the statewide average of 5.3 percent for the same year (EDD 2002a).

TABLE B.4.3.1–1.—*Employment and Income Profile in the Four-County Region*

	Alameda	San Joaquin	Contra Costa	Stanislaus	Region
Number of workers (2001 average)	754,900	264,700	509,800	210,300	1,739,700
Employed	721,000	241,600	493,100	188,800	1,644,500
Unemployed	33,900	23,100	16,700	21,500	95,200
Percent unemployed	4.5	8.7	3.3	10.2	5.5
LLNL Workforce (September 2002)					
Number of workers	4,919	1,636	1,132	533	8,220
Percent of 2001 workforce	0.7	0.6	0.2	0.3	0.5
Personal Income (2000 Average)					
Total personal income ($1,000)	55,972,377	13,208,972	39,194,448	10,302,276	108,375,797
Per capita ($)	38,624	23,242	41,110	22,889	36,479

Source: BEA 2002, EDD 2002a, LLNL 2002b.

San Joaquin County

The EDD reported a 2001 total employed labor force of 241,600 persons in San Joaquin County (Table B.4.3.1–1). This represented a 18.5 percent increase over the 1991 annual average of 203,900. The average 2001 unemployment rate was 8.7 percent (23,100 persons), which is substantially higher than the statewide average for that year (5.3 percent). Agricultural areas, such as San Joaquin County, tend to have greater seasonal variations in employment and higher unemployment rates. Robust job growth is expected through 2006, with services, retail trade, and government experiencing the greatest percentage increase (EDD 2002b).

Contra Costa County

The EDD reported a 2001 total employed labor force of 493,100 persons in Contra Costa County (Table B.4.3.1–1). This represented a 19.9 percent increase over the 1991 annual average of 411,400. The average annual unemployment rate for 2001 was 3.3 percent (16,700 persons), which was significantly lower than the statewide average of 5.3 percent for the same year (EDD 2002a).

Contra Costa County's varied economic base is dominated by the services industry, which accounts for 32 percent of total employment. The job growth forecast to 2006 indicates services jobs will grow at the greatest pace, followed by government and retail trade (EDD 2002b).

Stanislaus County

The EDD reported a 2001 total employed labor force of 188,800 persons in Stanislaus County (Table B.4.3.1–1). This represented a 20.6 percent increase over the 1991 annual average of 156,500. The average annual unemployment rate for 2001 was 10.2 percent (21,500 persons), which was significantly higher than the statewide average of 5.3 percent for the same year (EDD 2002a). Agricultural areas, such as Stanislaus County, tend to have greater seasonal variations in employment and higher unemployment rates.

While agriculture has traditionally been the basis of Stanislaus County's economy, other economic sectors are expanding dramatically. Growth is expected through 2006 in all major industries, with services, manufacturing, and retail trade experiencing the greatest percentage increases (EDD 2002b).

LLNL Workers by County and Major City

The majority of LLNL personnel reside in the Alameda County (see Table B.4.3.1–2), with the largest concentration (approximately 3,270 workers) residing in the city of Livermore. Recent shifts in population have led workers east, making the city of Tracy the second largest concentration of LLNL workers (approximately 720). The city of Pleasanton is home to 550 LLNL employees, while 420 reside in Manteca (LLNL 2002b).

In 2000, the population of Alameda County was 1,443,741. Of that total, 166,972 people lived within the communities of Livermore, Pleasanton, and Dublin, near the Livermore Site. In 2000, the population of San Joaquin County was 563,598. In 2000, the population of Contra Costa County was 948,816. In 2000, the population of Stanislaus County was 446,997 (Census 2002b).

LLNL is the largest employer in the city of Livermore, followed by the Livermore Valley Joint Unified School District (Table B.4.3.1–3).

TABLE B.4.3.1–2.—*Geographic Distribution of LLNL Workers by County and Major City*

County	Livermore Site	Site 300	Total
Alameda	4,871	48	4,919
San Joaquin	1,528	108	1,636
Contra Costa	1,108	24	1,132
Stanislaus	485	48	533
Other	622	11	633
Total	8,614	239	8,853
City			
Livermore	3,239	35	3,274
Tracy	674	48	722
Pleasanton	541	6	547
Manteca	390	32	422
Castro Valley	353	3	356
Modesto	251	28	279
Brentwood	231	8	239
San Ramon	235	1	236
Stockton	218	14	232
Dublin	188	2	190
Oakland	188	0	188

Source: LLNL 2002b.

TABLE B.4.3.1–3.—*City of Livermore Major Employers*

Employers	Description	Number of Employees
LLNL	Government Research and Development	8,000
Livermore Valley Joint Unified School District	Public school system	1,170
Sandia National Laboratories, California	Government research and development	950
Triad Systems Corporation	Computer systems	900
Valley Care Health System	Hospital	850
City of Livermore	City government	490
KLA-Tencor	Semiconductor inspection equipment manufacture	400
Bank of America	Warehouse and distribution	300
Wente Vineyards	Winery	320
Kaiser Permanente Regional Distribution Center	Warehouse and distribution	275
WalMart Stores	Retail	275
Trans Western Polymers, Inc.	Manufacturing	250
Form Factor	Electronic contact	230
Johnson Controls, Inc.	Manufacturing	200
Hexcel	Manufacturing	170
Costco Wholesale	Retail	164
Livermore Area Recreation and Park District	Government	170
Circuit City	Retail warehouse and distribution	150
Codiroli Motors	Retail	139
Dayton Hudson Corp/Target	Retail	130

Source: City of Livermore n.d.

Housing by County

The Alameda County housing stock (all units) totaled 546,735 units as of January 2002. The vacancy rate in the county was 3.0 percent, indicating a low percentage of available housing (DOF 2002).

The San Joaquin County housing stock (all units) totaled 197,279 units as of January 2002. The vacancy rate in the county was 3.9 percent, indicating a moderate percentage of available housing (DOF 2002).

The Contra Costa County housing stock (all units) totaled 361,748 units as of January 2002. The vacancy rate in the county was 2.9 percent, indicating a low percentage of available housing (DOF 2002).

The Stanislaus County housing stock (all units) totaled 156,515 units as of January 2002. The vacancy rate in the county was 3.7 percent, indicating a moderate percentage of available housing (DOF 2002). Table B.4.3.1–4 compares housing units and vacancy rates within the four-county Region of Influence (ROI) and selected cities for 1997 to 2002.

TABLE B.4.3.1–4.—*Housing Units and Vacancy Rates Within the Four-County Region of Influence and Selected Cities, 1997-2002*

	1997			2002			
County	**Housing Units**	**Occupied**	**% Vacant**	**Housing Units**	**Occupied**	**% Vacant**	**Housing Unit Growth (1997-2002)**
Alameda	521,101	495,598	4.9	546,735	530,115	3.0	4.7
San Joaquin	182,444	173,439	4.9	197,279	189,512	3.9	7.5
Contra Costa	342,980	325,659	5.1	361,748	351,134	2.9	5.2
Stanislaus	147,088	139,688	5.0	156,515	150,649	3.7	6.0
City							
Livermore	24,524	23,558	3.9	27,357	26,856	1.8	10.4
Tracy	15,953	14,687	7.9	20,571	20,040	2.6	22.4
Pleasanton	22,085	21,090	4.5	24,517	23,845	2.7	9.9
Manteca	15,616	15,011	3.9	18,649	18,023	3.4	16.3
Modesto	65,693	62,542	4.8	69,848	67,540	3.3	5.9
Brentwood	4,874	4,590	5.8	9,784	9,419	3.7	50.2
San Ramon	16,087	15,272	5.1	17,917	17,296	3.5	10.2
Stockton	79,420	75,333	5.1	84,266	80,722	4.2	5.8
Dublin	7,949	7,731	2.7	11,107	10,496	5.5	28.4
Oakland	154,640	144,285	6.7	158,607	151,843	4.3	2.5

Source: DOF 2002.

Economic Factors by County Including LLNL

Alameda and Contra Costa counties had a total of 69,993 business establishments in 2001, with a combined annual payroll of $38.7 billion (including LLNL) (Table B.4.3.1–5). The services industry was the largest source of revenue, with a $15-billion total payroll (EDD 2002c).

A total of 12,920 business establishments were located in San Joaquin County in 2001. Payroll for these companies totaled $5.0 billion during the year (Table B.4.3.1–5). The services industry was the largest source of revenue, with a $1.5-billion total payroll (EDD 2002c).

A total of 11,276 business establishments were located in Stanislaus County in 2001. Payroll for these companies totaled $4.1 billion during 2001 (Table B.4.3.1–5). The services industry was the largest source of revenue, with a $1.4 billion total payroll (EDD 2002c).

LLNL had an overall budget of $1.5 billion in FY2002. LLNL has a monthly payroll of approximately $59 million. LLNL payroll originates entirely from the Livermore Site in Alameda County, even though some personnel are located at Site 300 in San Joaquin County. As of FY2002, the total annual LLNL payroll was approximately $668 million, representing 1.7 percent of the total combined payroll generated by all business establishments in Alameda County. The RHWM would represent 3 percent of the overall LLNL effect.

LLNL contributes considerably to the economy in direct purchases; it purchased a total of $568 million in goods and services in FY2002. Of that total, $348 million was for purchases in California and $142 million was for purchases in Alameda County.

TABLE B.4.3.1–5.—*Annualized 2001 Payroll for Four-County Area by Industry Sector, 2001 ($1,000)*

Industry	Alameda/Contra Costa [a]	San Joaquin	Stanislaus
Agriculture	102,860	346,260	272,492
Mining	350,836	10,740	776
Utilities	222,976	65,700	11,764
Construction	3,493,652	511,460	384,844
Manufacturing	6,194,008	830,308	893,384
Wholesale Trade	2,898,288	281,700	212,284
Retail Trade	3,356,488	588,760	505,948
Transportation & Warehousing	1,484,200	409,728	120,728
Information	2,536,288	138,344	70,676
Finance & Insurance	2,260,504	235,992	151,368
Real Estate Rental & Leasing	655,652	66,392	40,804
Services	15,115,788	1,489,472	1,410,480
Total	**38,671,540**	**4,974,856**	**4,075,548**

Source: EDD 2002c.
[a] Combined Oakland Metropolitan Statistical Area.

B.4.3.2 *Environmental Justice*

Environmental justice has been defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (EPA 2002a). Concern that minority and/or low-income populations might be bearing a disproportionate share of adverse health and environmental impacts led President Clinton to issue an Executive Order (EO) in 1994 to address these issues; EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," directs Federal agencies to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. When conducting NEPA evaluations, the NNSA incorporates environmental justice considerations into both its technical analyses and its public involvement program in accordance with the U.S. Environmental Protection Agency (EPA) and the CEQ regulations (CEQ 1997).

The NNSA selected an area of influence within a 50-mile radius of the Livermore Site and Site 300 for analysis, an area that encompasses all or portions of 19 counties. This area of influence was selected to be consistent with possible effects evaluated as part of the air impacts and accident consequence analyses.

Identifying Minority and Low-Income Populations

For this analysis, minority populations are considered to be all *people of color*, which includes all ethnic and racial groups except non-Hispanic whites. For California, the minority population is 53.3 percent. Chapter 4, Figure 4.3.5–1, of this LLNL SW/SPEIS shows the location of census block groups within the 50-mile area of influence where the minority population is greater than 53.3 percent.

For this analysis, low-income populations are those individuals living below the poverty threshold, as defined by the 2000 Census. This threshold varies from a household income of $8,259 to $38,138, depending on the number and age of household members. For California, the percent of the population living in poverty is 14.2 percent. Chapter 4, Figure 4.3.5–2 of this LLNL SW/SPEIS shows the location of census block groups within the 50-mile area of influence where the low-income population is greater than 14.2 percent.

Livermore Site

Minority Populations

A total population of 7,256,274 resides within a 50-mile radius of the Livermore Site. Of these, 3,743,027, or 51.6 percent, are minorities. This percentage is less than the minority percentage in the State of California as a whole. There are no block groups within a 5-mile radius that are categorized as minority. An area of Alameda County approximately 10 miles west of the Livermore Site is categorized as minority. Within 20 miles, higher concentrations of minorities are found within portions of western Alameda County and San Joaquin County in the Central Valley.

Low-Income Populations

Of the total population of 7,256,274 within the 50-mile area of influence, 711,571, or 9.8 percent, are low income. This percentage is less than the low-income percentage in the State of California as a whole. There are no block groups within a 10-mile radius of the Livermore Site that have percentages of low-income populations greater than the state average. Within 20 miles, some higher concentrations of low-income populations are located in the eastern portion of Contra Costa County, San Joaquin County, the southwestern portion of Alameda County, and the northern portion of Santa Clara County.

Site 300

Minority Populations

A total population of 6,406,704 resides within a 50-mile radius of Site 300. Of these, 3,343,660, or 52.2 percent, are minorities. This percentage is less than the minority percentage in the State of California as a whole. There are no block groups within a 5-mile radius that are categorized as minority. Several areas of San Joaquin County approximately 9 miles north and northeast of Site 300 are categorized as minority. Within 20 miles, higher concentrations of minorities are found within western portions of San Joaquin and Stanislaus counties in the Central Valley.

Low-Income Populations

Of the total population of 6,406,704 within the 50-mile area of influence, 654,156, or 10.2 percent, are low income. This percentage is less than the low-income percentage in the State of California as a whole. There are no block groups within a 5-mile radius of Site 300 that have percentages of low-income populations greater than the state average. Within 10 miles, two areas of western San Joaquin County to the north and northeast of Site 300 are categorized as low income. Within 20 miles, some higher concentrations of low-income populations are located in

the western portions of San Joaquin and Stanislaus counties, and the northern portion of Santa Clara County.

B.4.4 Community Services

This section describes the existing demands on fire protection and emergency services, police protection and security services, school services, and nonhazardous solid waste disposal from the operation of LLNL.

B.4.4.1 *Fire Protection and Emergency Services*

The Fire Safety Division at the Livermore Site occupies two facilities: a fire station at Building 323 (Fire Station No. 1) and an emergency dispatch center at Building 313. All Livermore Site health and safety alarms are received by the emergency dispatch center through the site-wide alarm system. In addition to monitoring the Livermore Site alarms and dispatching personnel, the emergency dispatch center serves as the Mutual Aid Dispatch Center for Twin Valley and Alameda County, as appropriate.

There are about 62 fire protection and emergency services personnel at LLNL in the following categories: fire protection engineering and fire prevention, training, emergency dispatch, and emergency operations. A minimum staff of eight is on duty at Fire Station No. 1. LLNL Fire Station No. 1 equipment consists of four large-capacity pumpers (1,500 to 1,000 gallons per minute) including one ladder truck and one four-wheel drive, one smaller capacity (325 gallons per minute) four-wheel drive pumper, a special services unit with hazardous material containment equipment, two ambulances, and three command vehicles.

The average LLNL Livermore Site Fire Department response time onsite is 3.5 minutes. One vehicle and four personnel will initially respond to a call onsite. Additional equipment and personnel will respond as needed. Table B.4.4.1–1 provides a summary of the numbers and types of onsite emergency calls to which the LLNL fire safety division responded in 1999, 2000, 2001, and 2002.

Table B.4.4.1–1.—*Summary of Emergency Response Calls for 1999 through 2002*

Type of Incident	Number of Incidents							
	1999		2000		2001		2002	
	Livermore Site	Site 300[a]	Livermore Site	Site 300[a]	Livermore Site	Site 300[a]	Livermore Site	Site 300[a]
Ambulance	141		120		142		196	
Fire	466		319		341		394	
Hazardous materials	74		66		69		61	
Mutual/automatic aid[b]	683		668		1,079[c]		885[c]	
Total	**1,364**	**59**	**1,173**	**68**	**1,631**	**59**	**1,536**	**65**

Source: LLNL 2003b.
[a] Site 300 emergency response calls are not categorized by incident type.
[b] Includes responses under agreements with offsite agencies.
[c] Increase from previous years primarily due to expansion of service area and calls on and after September 11, 2001.

At the Livermore Site, the ambulances transport patients to a medical facility that offers care commensurate with the severity of the injury (based on evaluation using emergency medical service protocols). These facilities include the onsite Health Services Department, Valley Care Medical Center (Pleasanton), or Eden Medical Center (Castro Valley).

The LLNL Fire Safety Division participates in several automatic and mutual aid agreements with various offsite agencies. Automatic aid is dispatched without request on a first alarm. Mutual aid assistance is specifically requested after local agency resources have been depleted. LLNL participates in automatic and mutual aid agreements with the city of Livermore Fire Department and the Alameda County Fire Patrol, respectively. LLNL participates in a mutual aid network that extends throughout the State of California.

The LLNL Fire Department responds to approximately 300 of the Livermore/Pleasanton Fire Department's total annual calls. Conversely, the Livermore/Pleasanton Fire Department responds to 3 of the Livermore Site's total annual calls. LLNL responds to an average of 300 Alameda County Fire Patrol calls per year; the Alameda County Fire Patrol typically is not called on to respond to LLNL calls. The California Department of Forestry, which provides mutual aid to Site 300, does not respond to mutual aid requests at the Livermore Site because it does not maintain structural fire equipment. The Livermore Site fire station assists with approximately three wildland fires per year within the California Department of Forestry's jurisdiction. This constitutes less than 1 percent of the California Department of Forestry's total annual calls (LLNL 2003b).

LLNL Fire Station No. 2 is located in Building 890 at Site 300. This facility is part of the overall Fire Safety Division of LLNL and is operated under the direction of the LLNL Fire Chief. The minimum staff level at Fire Station No. 2 is four personnel. LLNL Fire Station No. 2's equipment consists of two large (1,250 and 1,000 gallons per minute) pumpers (the smaller of which is four-wheel drive), one four-wheel-drive pumper (325 gallons per minute), and one ambulance.

The average Site 300 fire station response time onsite is 4.5 minutes. One vehicle and four personnel respond from the Site 300 fire station. In addition, a vehicle from the Livermore Site responds as a "cover" in case an additional fire breaks out. The response time to the Site 300 main gate from the Livermore Site is approximately 15 minutes. Table B.4.4.1–1 provides the number of onsite emergency calls to which the Site 300 Fire Department responded in 1999, 2000, and 2001.

At Site 300, the ambulance transports patients to a medical facility that offers care commensurate with the severity of the injury (based on evaluation using emergency medical service protocols). These facilities include the Sutter Hospital in the city of Tracy or the nearest trauma center.

The LLNL Fire Safety Division maintains mutual aid agreements with several agencies, including the city of Tracy and the California Department of Forestry that could serve Site 300.

The city of Tracy Fire Department and the Site 300 fire station typically do not request aid from each other. The Site 300 fire station has not historically responded to calls within the Tracy Rural County Fire Protection District's jurisdiction. Conversely, the Tracy Rural County Fire Protection District typically receives one call annually from Site 300. The State of California

Department of Forestry and the Site 300 fire station respond to an average of less than three of each other's calls per year (LLNL 2003b).

B.4.4.2 *Police and Security Services*

Police and security services at LLNL are provided by the Protective Force Division of the Safeguards and Security Department. It is the function of the Protective Force Division to provide protection of LLNL personnel and assets (including RHWM staff and facilities). This protection is provided through several elements, including access control, fixed access and surveillance points, random vehicle and foot patrols, response elements, and special response team elements.

The Protective Force Division provides emergency response service to the Livermore Site and Site 300 and has contingency plans to cover credible emergencies, including work stoppages, bomb threats, natural disasters, site-wide evacuations, callout procedures, satellite command center activation procedures, executive protection, alarm response procedures, and civil disorders.

LLNL participates in emergency response agreements with the city of Livermore Police Department, the Alameda County Sheriff's Department, the San Joaquin County Sheriffs Department, the State of California Highway Patrol (CHP), and the Federal Bureau of Investigation (FBI). Offsite agencies generally provide first alarm response to LLNL offsite leased properties (LLNL 2002bz).

The city of Livermore Police Department is rarely requested to respond to calls at the Livermore Site through its emergency response agreement. The Alameda County Sheriff's Department responds to an average of six calls at the Livermore Site per year, which is less than 1 percent of the agency's total annual calls. Site 300 is within Patrol District 8 of the San Joaquin County Sheriff's Department. LLNL did not request assistance from the Sheriff's Department within the past year. The CHP responds to calls from the LLNL Safeguards and Security Department during large-scale demonstrations that have the potential to block Vasco Road and Greenville Road. The CHP responds to calls for crowd control from the LLNL Safeguards and Security Department on an average of once per year. There is occasional interaction with the FBI for criminal and security investigations (LLNL 2002bz).

B.4.4.3 *School Services*

In 2001–2002, student enrollment totaled 606,967 in the region (Table B.4.4.3–1). The local school district is the Livermore Valley Joint Unified School District and includes schools from kindergarten through high school. The local school district serves over 10,000 students from a 240-square mile area that includes the city of Livermore. There is no available information on the number of children of LLNL employees that attend district schools.

TABLE B.4.4.3–1.—*Education in the Region of Influence*

	Alameda	San Joaquin	Contra Costa	Stanislaus	ROI
School Enrollment	217,591	127,354	161,742	100,280	606,967

Source: California Department of Education 2003.

B.4.4.4 *Nonhazardous and Nonradioactive Solid Waste Disposal*

Nonhazardous solid waste generated at the Livermore Site is transported to the Altamont Landfill for disposal. The landfill is estimated to have sufficient capacity to receive waste until the year 2038 (Hurst 2003). The current total daily permitted throughput at the Altamont Landfill is 11,150 tons per day (SWIS 2002).

During 2002, approximately 5,650 metric tons of solid sanitary waste were collected and transported to the Altamont Landfill from the Livermore Site (LLNL 2003bd). Construction wastes make up approximately two-thirds of this total generation, and the remaining one-third consists of plastics, glass, other organics, and other wastes. This waste is stored in 222 onsite containers with average volume capacities of 4 cubic yards each. Waste from 178 of the containers is collected and disposed of daily at the Altamont Landfill by LLNL workers. Waste from the other 31 containers is collected and disposed of twice weekly (remaining containers less frequently) by the same method. In addition, approximately 63.5 tons of landscape clippings (chips, mulch, street sweepings) are composted each month (SWIS 2002, LLNL 2003bd). There are no plans to expand the Livermore Site nonhazardous solid waste storage facilities or to modify nonhazardous waste disposal methods.

In 2002, LLNL diverted almost 60 percent of the 15,300 metric tons of its nonhazardous waste for recycling and reuse. A portion of the nonhazardous waste generated annually is sold for recycling or reuse. Additionally, soil is reused at the Livermore Site and at the landfill for daily cover (LLNL 2002cc). Approximately 560 tons of landscape clippings were composted in 2002 (LLNL 2003bd).

Site 300 wastes are transported to the city of Tracy Material Recovery and Solid Waste Transfer station prior to final disposal. Site 300 represents approximately 3 percent of the LLNL total.

B.4.5 Prehistoric and Historic Cultural Resources

Livermore Site

Records searches conducted prior to and for the 1992 LLNL EIS/EIR did not reveal the presence of prehistoric resources on the Livermore Site (LLNL 1992a). Field surveys conducted by Holman & Associates in the undeveloped western and northern perimeter areas, including a 500-foot wide buffer and undeveloped area survey conducted in 1991, did not reveal the presence of prehistoric resources (LLNL 1992a). Because most of the Livermore Site is developed, the likelihood of finding unrecorded and undisturbed prehistoric sites is low; however, there is still the possibility that undisturbed prehistoric sites lay buried under the modern landscaping.

The Livermore Site has a number of buildings associated with historic events or significant LLNL achievements. Some of the buildings and facilities, or groups of them at the Livermore Site, may be eligible for listing in the National Register of Historic Places (NRHP). To facilitate

evaluation of the properties, an historic context is being developed and analysis of specific individual properties is in progress (LLNL 2002bj). To date, DOE and the State Historic Preservation Officer (SHPO) have evaluated and concurred that 50 buildings are not eligible for listing on the NRHP. The negative or not eligible determinations include the following buildings: 177, 222, 251, 317, 328A, 412, 431, 490, 592, 593, 1253, 1477, 1478, 1482, 1601, 1602, 1631, 1734, 1877, 2512, 2527, 2529, 2530, 2629, 2685, 2687, 2626, 2801, 2802, 2808, 3629, 3703, 3751, 3777, 3903, 3904, 3905, 3907, 3982, 4107, 4180, 4302, 4377, 4378, 4383, 4384, 4387, 4388, 4440, 4442, 8011, and 8806 (LLNL 2003ca).

Site 300

Site 300 has been surveyed for both prehistoric and historic cultural resources and a number of potentially significant prehistoric and historic sites have been identified (LLNL 1992a). The resources include rock shelters and other areas used for the making of stone tools, and the historic Town Site of Carnegie. No formal subsurface testing program has occurred and formal NRHP eligibility determinations are incomplete. Further investigation and delineation of the known resources has resulted in the formation of four archaeological sensitivity areas (LLNL 2002bj). Projects in Sensitive Areas II, III, and IV require that the LLNL archaeologist be contacted. Projects in Sensitive Area I do not require this. Development or ground disturbing activities have not been permitted in or within 300 feet of the delineated areas unless the activity was approved or monitored by LLNL archaeologists (LLNL 2002bj). The EWSF and Building 883 are located in Sensitive Area I. The EWTF is located in Sensitive Area II and requires a LLNL archaeologist be contacted on any projects, including permit modifications.

B.4.6 Aesthetics and Scenic Resources

The Landscape Architecture Master Plan for LLNL provides guidance for development at LLNL (LLNL 2002d). Because there are no strict standards at LLNL for matching exterior building color or style, the landscape architecture planning process is the only means of creating cohesiveness in image. The Landscape Architecture Master Plan is intended to ensure that all site improvements are architecturally compatible with their immediate surroundings and that other aesthetic qualities, such as temperature, wind, and glare are enhanced.

The Livermore Site is within Alameda County. In addition, the western 1,100 feet of the Livermore Site is within the city of Livermore. Most of Site 300 is within San Joaquin County, with a small portion in Alameda County. Because LLNL is a Federal facility owned by DOE, the surrounding cities and counties have no planning jurisdiction for the site. Nevertheless, LLNL does consider local planning policies, to the extent practicable, in its land decisions as a good neighbor policy.

B.4.6.1 *Visual Character of the Project Area*

Regional Character

The Livermore Valley of eastern Alameda County, where the Livermore Site is located, is ringed by hills and mountains that define the regional view shed and provide open space around the development on the valley floor. The terrain in the vicinity of the sites ranges from relatively flat land to gently rolling hills. The hills east and south of the Livermore Site gradually become steeper as they trend eastward to form the Altamont Hills of the Diablo Range. Wind turbines

north and south of the Altamont Pass punctuate the eastern horizon and have become part of the eastern valley landscape identity.

Site 300 is located in the Altamont Hills of the Diablo Range. This area is largely grasslands and low shrubs in areas ranging in topography from gently rolling hills to steeply sloping ridges and drainages. View sheds in the area around Site 300 are severely constrained by topography.

Livermore Site

The Livermore Site has a campus-like or business park-like setting with buildings, internal roadways, pathways, and open space. Portions of the site along the western and northern boundaries remain largely undeveloped and serve as security buffer zones. A row of eucalyptus and poplar trees surrounds much of the developed portion of the Livermore Site and screens most ground-level views of the facility. Onsite buildings range in height from 10 feet to approximately 110 feet. A 9-foot chain-link and barbed-wire security fence surrounds the Livermore Site. The most prominent buildings in the public view shed are the administrative building off of East Avenue in the southwest corner of the site and the NIF in the northeast corner. Both of these buildings are visible from locations along adjacent roads.

The area surrounding the Livermore Site is a mixture of rural and pastoral uses and urban development. SNL/CA is located immediately south of the Livermore Site. Rural residences and grazing land are the primary visual features to the east. The area west of the Livermore Site is occupied by detached residences giving the area a suburban character. A small area of commercial use occupies lands immediately southwest of LLNL. The commercial area is surrounded by a mixture of vineyards and residential uses, although residential development is currently underway and the visual character of the area is shifting from pastoral to suburban. The area north of the Livermore Site to I-580 is industrial, primarily one- and two-story industrial buildings, business parks, and the Union Pacific railroad line that traverses the area. This area is visually similar with the research, business, and industrial character of the Livermore Site.

Site 300

The main gate and GSA of Site 300, including a number of buildings, roads, and infrastructure, are foreground and middle-ground features in view from Corral Hollow Road, which forms the southern boundary of Site 300. Vegetative screening and topography partially obscure many of the features associated with the GSA. The majority of Site 300 is obscured from view by topography.

The surrounding area is primarily undeveloped open space or rural, with some exceptions. Fireworks America is adjacent to and northeast of Site 300. Although the sign at the entrance to the facility is visible from Corral Hollow Road, structures associated with this facility are obscured by topography. The SRI International Testing Facility is approximately 0.6 mile south of Site 300 and is not visible from Corral Hollow Road.

Carnegie State Vehicular Recreation Area, located south of the western portion of Site 300, is used for off-road vehicle use. The park includes dirt trails on the surrounding hillsides and a ranger station, picnic areas, and several contoured riding areas in the valley floor adjacent to Corral Hollow Road. These features are all visible from Corral Hollow Road. The high degree of

modification is substantially out of character with the surrounding open space and rural features of the area.

B.4.6.2 *Sensitive Views in the Surrounding Area*

Locations of visual sensitivity are defined in general terms as areas where high concentrations of people may be present or areas that are readily accessible to large numbers of people. No visually sensitive locations are defined on the Livermore Site or Site 300. The visual sensitivity of areas surrounding the Livermore Site and Site 300 are described below.

Livermore Site

Sensitive views around the Livermore Site include residential areas and scenic routes or visual amenities designated by the city of Livermore or Alameda County.

The Livermore Site is not visible from several designated scenic resource areas (e.g., Wente and Concannon wineries, Tesla historical town site, Altamont Pass Road, Cross Road, and Mines Road) and is only minimally visible from several other designated scenic resource areas as a result of distance or intermittent topography. The Livermore Site is relatively distant from I-580 (approximately 1.5 miles) and views are obstructed by vegetation and development. Only the tallest onsite building on the Livermore Site is intermittently visible from this highway. The Livermore Site is not visible from most of Flynn Road but does occupy the middle-ground views from the western end of Flynn Road. As a result of distance, the facilities are visually indistinct and are consistent with surrounding development. The view of the Livermore Site from Tesla Road is almost completely obstructed by intervening topography.

The Livermore Site is prominently visible from residences near and motorists traveling along Vasco Road. Vegetation that surrounds the Livermore Site obstructs or partially screens most views of the facilities from this area. The buffer zone also provides visual separation between the Livermore Site and surrounding viewers.

The Livermore Site is also visible from residences and vineyards to the southwest, and to motorists traveling north on Vasco Road. Security buffer area and vegetation provide partial screening of the Livermore Site from this view. In addition, residential and vineyard development in this area is currently taking place and will further screen views of the facilities.

The Livermore Site is prominent in views from most of Greenville Road. Although Greenville Road follows the eastern boundary of the Livermore Site, views from this portion of the road are heavily screened by vegetation. Views from Greenville Road south of the Livermore Site are more panoramic due to the elevated viewing perspective, but are partially screened by the rolling topography. The Livermore Site is visually distinct in the foreground and middle ground, but is visually consistent with the overall pattern of development in the view shed.

The Livermore Site is prominent in views from the western portions of Patterson Pass Road from Vasco Road to Flynn Road. Views from Patterson Pass Road adjacent to the Livermore Site, similar to those described for Vasco Road, are largely screened by vegetation and are separated from viewers by a security buffer area. Views toward the west from the lower reaches of Patterson Pass Road are similarly obstructed by vegetation. Views of the facilities from the higher reaches of Patterson Pass Road are obstructed by topography.

Site 300

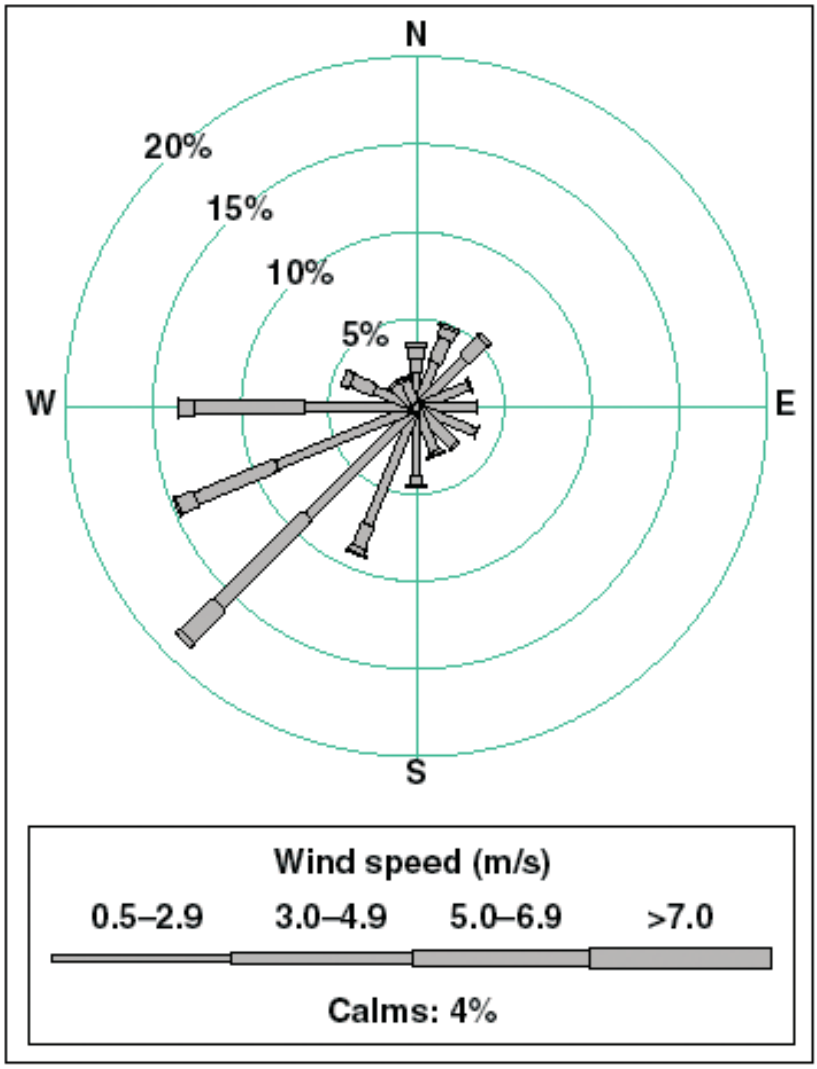
Sensitive views around Site 300 include the Carnegie State Vehicular Recreation Area and scenic routes designated by Alameda County or San Joaquin County.

Site 300 is not within the view shed of any of designated scenic corridors except for a very short section of Tesla Road at the eastern end of Alameda County. Tesla Road becomes Corral Hollow Road in San Joaquin County. Corral Hollow Road follows the southern boundary of Site 300 and affords views of the site, but is not designated as a scenic corridor. Corral Hollow Road, which is adjacent to and south of Site 300, is the nearest public roadway with a view of the site. The view of Site 300 from Corral Hollow Road is of parking areas and several single-story structures in the GSA. The remainder of the view of Site 300 from Corral Hollow Road consists of rolling hillsides and a few scattered small structures on the hilltops. Other than the GSA, the facilities of Site 300 are not apparent in landscape views from publicly accessible viewpoints; however, a 3-foot-high wire fence surrounding Site 300 is visible from Corral Hollow Road, along the site's southern boundary.

Site 300 can be seen from the Carnegie State Vehicular Recreation Area, which lies directly south. One single-story structure (Building 899) and its surrounding light posts are visible from the recreation area. From the picnic area near the park entrance, the view of Site 300 consists primarily of undeveloped hillsides.

B.4.7 Meteorology

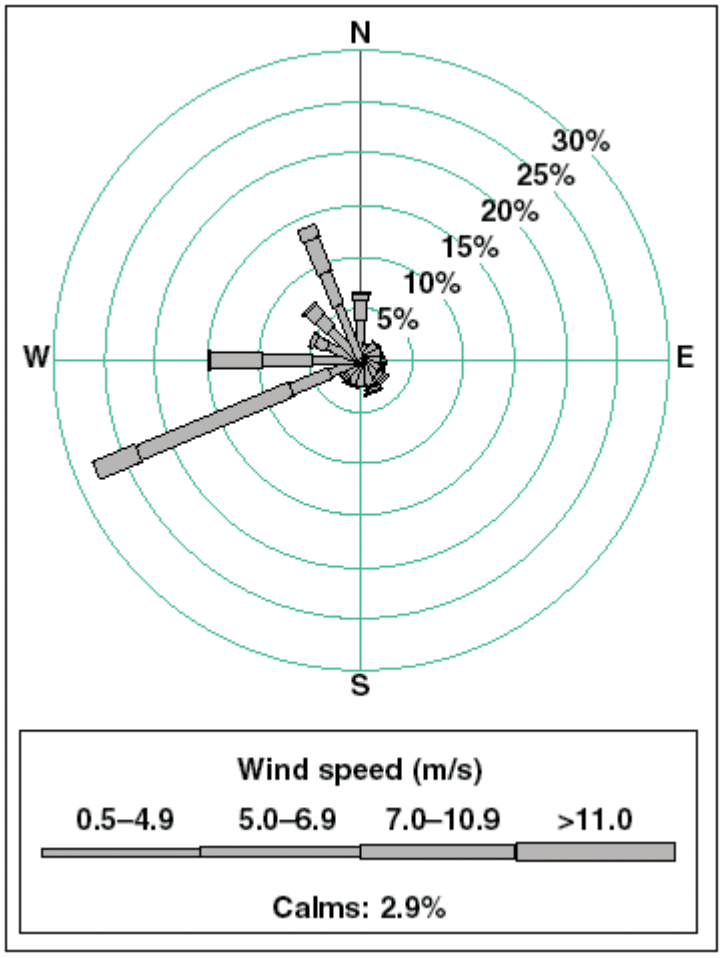
Meteorological data (including wind speed, wind direction, rainfall, humidity, solar radiation, and air temperature) are continuously gathered at both the Livermore Site and Site 300. Mild, rainy winters and warm, dry summers characterize the climate. The mean annual temperature for the Livermore Site in 2001 was 58.5°F. The mean annual temperature for Site 300 in 2001 was 59°F. Temperatures range from 23°F during some predawn winter mornings to 104°F during some summer afternoons. Both rainfall and wind exhibit strong seasonal patterns. These wind patterns tend to be dominated by the thermal draw of the warm San Joaquin Valley that results in wind blowing from the cool ocean toward the warm valley, increasing in intensity as the valley heats up. The wind blows from the northeast primarily during the winter storm season. Most precipitation occurs between October and April, with very little rainfall during the warmer months. Annual wind data for the Livermore Site are given in Figure B.4.7–1. These data show that about 50 percent of the wind comes from the southwest to westerly direction. This prevailing pattern occurs primarily during the summer. During the winter, the wind often blows from the northeast. Based on a 10-year record, the highest and lowest annual rainfalls were 21 and 7.2 inches, respectively and the average annual rainfall was 14 inches. In 2001, the Livermore Site received 13.4 inches of rain.



Source: LLNL 2002bx, LLNL 2002ci.

FIGURE B.4.7–1.—*Wind Rose Showing the Frequency of Occurrence for Wind Speed and Direction at the Livermore Site, 2001*

The meteorological conditions at Site 300, while generally similar to those at the Livermore Site, are modified by higher elevation and more pronounced topological relief. The complex topography of the site significantly influences local wind and temperature patterns. Annual wind data are presented in Figure B.4.7–2. The data show that winds are more consistently from one wind direction, the west-southwest, and reach greater speeds than at the Livermore Site. Rainfall for 2001 was 9.7 inches at Site 300. As in the case for the Livermore Site, precipitation is seasonal, with most rainfall occurring between October and April.



Source: LLNL 2002bx, LLNL 2002ci.

FIGURE B.4.7–2.—*Wind Rose Showing the Frequency of Occurrence for Wind Speed and Direction at Site 300, 2001*

B.4.8 Geological Resources and Hazards

This section provides a summary of the affected physical environment, including discussions of the local and regional geological setting, stratigraphy, soils, structural geology, and geographic hazards (including seismicity) for both the Livermore Site and Site 300 relative to the RHWM facilities.

B.4.8.1 *Livermore Site Geological Setting Overview*

The Livermore Valley is an east-west trending synclinal structure composed primarily of gently deformed alluvial deposits overlying complexly deformed Cenozoic and Mesozoic rocks. Most of the faults in the region are right-lateral strike-slip faults associated with the San Andreas Fault system. The Livermore Valley is bordered by the Calaveras Fault to the west, the Greenville Fault to the east, the Tassajara Hills and Mount Diablo to the north, and the Diablo Range to the south.

The oldest rock units exposed in the Livermore area consist of the highly deformed sedimentary, igneous, and metamorphic rocks of the Jurassic-Cretaceous Franciscan Assemblage. These rocks are structurally overlain by the Cretaceous Great Valley Sequence, consisting of alternating beds of sandstone, siltstone, and shale. Both of these units are intricately folded and faulted in the mountains surrounding the Livermore Valley.

Stratigraphy—Radioactive and Hazardous Waste Management Facilities

The sediments beneath the Livermore Site are late Tertiary and Quaternary alluvial sediments known as the Livermore Formation. The maximum thickness of the Livermore Formation is thought to be approximately 4,000 feet. This formation has been divided into Upper and Lower Members. The Upper Member of the Livermore Formation is characterized by massive gravel beds mixed with sand, silt, and clay. The Lower Member of the Livermore Formation is dominated by greenish- to bluish-grey silt and clay, with lenses of gravel and sand (DOE 2001a).

Structure—Radioactive and Hazardous Waste Management Facilities

The Livermore Site is located near the boundary between the North American and Pacific tectonic plates, and the area is characterized by the San Andreas Fault system that trends northwest. The Diablo Range, which includes the Altamont Hills, is part of the northwest-trending Coast Ranges, and parallels three major faults in the area: the San Andreas Fault system, the Sur-Nacimiento Fault, and the Coast Range thrust fault system (the Sur-Nacimiento Fault and the Coast Range thrust). These faults can generally be considered to define three different lithologic blocks. The westernmost block is the Salinian Block, consists primarily of metamorphic and granitic rock. To the east of the Salinian Block is the Franciscan Assemblage, lying between the San Andreas and the Coast Range thrust fault zones. It is composed of marine sedimentary and volcanic rocks. The next block positioned above the Coast Range thrust fault zone consists of late Mesozoic through late Tertiary marine sedimentary rocks overlying complex ancient oceanic and continental crust rocks. This block lies primarily along the eastern margin of the Coast Range Province. Structural relationships along the Coast Range thrust are complex due to later reactivation of the thrust by high-angle normal and strike-slip faults.

The Hayward Fault, which is part of the San Andreas Fault system (see Figure B.4.8.1–1), forms the western boundary of the East Bay Hills and is located about 17 miles west of the Livermore Site. Another branch of the San Andreas Fault system, the Calaveras Fault zone, trends northwest through the San Ramon Valley, which borders the Livermore Valley to the west. A major structural feature north of the Livermore Valley is the Mount Diablo Complex. This complex consists of folded and thrust-faulted rock in the vicinity of Mount Diablo and the surrounding hills. This complex is bordered on the northeastern edge by the Green Valley-Clayton Fault system. The Suisun Bay is to the north and the Livermore Valley to the southeast flank of the Diablo Complex. The two regional northwest-southeast trending fault zones located closest to the Livermore Site waste management facilities are the Greenville Fault zone and the Tesla-Las Positas Fault zones.

None of the Livermore Site waste management facilities, including the DWTF, are located within 200 feet of an active fault. The north branch of the Las Positas Fault is the closest fault to Livermore Site waste management facilities. The Las Positas Fault is approximately 2,700 feet south of the DWTF. The DWTF is approximately 3,500 feet west of the nearest potentially active fault strands in the Greenville Fault zone (LLNL 2002da).

Soils—Radioactive and Hazardous Waste Management Facilities

The soils beneath the Livermore Site are formed primarily upon sediments deposited by local streams. Four soils cover most of the Livermore Site vicinity. In order of decreasing extent these soils are Rincon loam (Areas 612 and 514 and Buildings 280 and 233 CSU), Zamora silty clay loam, San Ysidio loam, Yollo gravelly loam, and Rincon clay loam (DWTF). These soils are primarily Alfisols, or moderately developed soils, and grade into Mollisols, which are grassland soils (LLNL 2001af).

Seismicity—Radioactive and Hazardous Waste Management Facilities

Three principal components of the San Andreas Fault system in the San Francisco Bay Area, the San Andreas, Hayward, and Calaveras faults, have produced the majority of significant historical earthquakes in the Bay Area. These three faults also accommodate the majority of slip along the Pacific and North American plate boundary and they would likely continue to generate moderate to large earthquakes more frequently than other faults in the region. The potential for local, damaging earthquakes was highlighted by the January 1980 Livermore earthquake sequence on the Greenville fault, which produced two earthquakes of magnitudes 5.5 and 5.6 on the Richter Scale. The earthquake caused structural and nonstructural damage to the LLNL facilities. In most cases, earthquakes in the Livermore Valley region have occurred on strike-slip faults, generally indicating north-south-oriented compression. The fault segment nearest LLNL may be capable of generating a magnitude 6 to 6.5 earthquake (LLNL 2002da). A recent U.S. Geological Survey study of the likelihood of major earthquakes in the San Francisco Bay Area has determined that there is a 62 percent probability of one or more earthquakes with a magnitude of 6.7 or greater occurring with 30 years (USGS 2003). The study concluded that the probability of these earthquakes occurring along the Calaveras, Greenville, and Mt. Diablo Thrust faults within the next 30 years was 11 percent, 3 percent, and 3 percent, respectively. The study calculated that there was a 50 percent chance of the Livermore area exceeding a ground shaking of Modified Mercalli (MM) intensity VII to VIII.

The existing waste management facilities were built to the seismic criteria required at the time of their construction. Any structural modifications to these buildings are done in accordance to the Uniform Building Code (UBC) standards in place at the time of modification. All new construction at the Livermore Site is in accordance with the criteria specified in DOE O 6430.1A and current UBC standards. LLNL follows the criteria of the Seismic Safety Program of the *Health and Safety Manual*.

Buildings 612, 614, and 625 have been seismically reviewed and have received a performance rating of “Good,” which indicates that during a major seismic disturbance some structural and nonstructural damage and falling hazards may result, but that these would not significantly jeopardize life.

Building 693, built in 1987, was constructed to meet the 1985 UBC seismic standards, which were the standards in effect at that time. Building 280 meets the 1994 and all previous UBC seismic standards. DWTF has been designed to meet 1994 UBC seismic standards.

B.4.8.2 *Site 300 Geologic Setting Overview*

Site 300 occupies approximately 7,000 acres of steep ridges that decrease in elevation toward the southeast. The lowest elevation onsite, where Corral Hollow Creek follows the southern Site 300 southern boundary, is approximately 500 feet above mean sea level. The principal faults in the vicinity of Site 300 are the Corral Hollow-Carnegie, Black Butte, and Midway faults. These faults are discussed in detail in Appendix H. The active Carnegie Fault of the Corral Hollow-Carnegie Fault zone crosses the southern portion of the site. The Elk Ravine Fault, a complex structure composed of pre-Holocene strike-slip faults, reverse faults, normal faults, and local folds, crosses Site 300 from the northwest corner to the southeast corner (Dibblee 1980d). Site 300 soils have developed on marine shales and sandstones, uplifted river terraces, and fluvial deposits. They are classified as loamy Entisols. Entisols are young soils that have little or no horizon development. Clay-rich soils, known as Vertisols, are also present and have been mapped as the Alo-Vaquero Complex. Vertisols are mineral soils characterized by high clay content that display shrink/swell capability. The remaining soil types identified at Site 300 occur only in limited areas. These units are mixtures of soils described and are not readily separable, including grassland Mollisols, or are poorly developed Inceptisols (USDA 1966, 1990).

Stratigraphy—Site 300 Radioactive and Hazardous Waste Management Facilities

The Building 883 area is underlain by unconsolidated Quaternary alluvial and terrace deposits associated with old and present-day stream channels of Corral Hollow Creek. These deposits consist of brown clay, silt, sand, and gravel lenses. Quaternary alluvial deposits predominate in the near Building 883. The Quaternary terrace remnants represent deposits of ancestral Corral Hollow drainage systems. The units are essentially flat-lying in the area and unconformably overlie the late Miocene Neroly and Cierbo Formations. In general, the Neroly Formation in the GSA and vicinity is composed of poorly consolidated, blue-weathering volcaniclastic sandstone and siltstone with interbedded claystone and rare conglomerate. Neroly Formation beds dip generally from 80° to 18° southwesterly.

All three regional stratigraphic members that comprise the Neroly Formation have been encountered in wells drilled in the area: upper blue sandstone member, middle claystone member, and lower blue sandstone. The uppermost, locally recognized, stratigraphic member of the Neroly Formation, upper siltstone and claystone, is not present in the Building 883 area. Its absence may reflect either nondeposition or erosion prior to deposition of the latest overlying Tertiary deposits. The blue-gray sandstone underlies areas east and west of Site 300 and is exposed to the east.

Structure—Site 300 Radioactive and Hazardous Waste Management Facilities

The EWTF located near the center of Site 300 is underlain by interbedded sandstones, claystones, and conglomerates that comprise the lower portions of the late Miocene Neroly formation. This formation underlies most of Site 300. Groundwater underlies the EWTF at depths that vary from 80 to 130 feet (LLNL 1997i).

The nearest fault mapped in the vicinity of the EWTF is the Elk Ravine Fault that passes about 1,000 feet to the northeast. Repeated studies of various strands of this fault have shown no evidence of Holocene activity (LLNL 1997i).

The EWTF is located in the south central portion of Site 300. Available geological mapping studies indicate that the storage magazines are excavated into Quaternary terrace gravels and underlain by dense, semilithified clays, silts, and silty sands correlated with the Pliocene nonmarine sequence of Dibblee. The Neroly Formation underlies the area at greater depths and probably is host to the regional water table (LLNL 1997i).

The nearest mapped fault to the EWTF is the unnamed fault identified in 1982 during early geologic mapping studies. In the northeastern portion of Site 300, this fault appears to offset the contact between the Neroly Formation and the Pliocene nonmarine sequence about 50 feet vertically. No detailed studies are available (LLNL 1997i).

The principal faults mapped in the vicinity of Building 883 include the Corral Hollow-Carnegie Fault system. The Carnegie Fault trends northwest-southeast in the southwest part of Site 300 and merges with the Corral Hollow Fault southwest of the Building 883. This fault system is considered to be active. Within the area, a reverse fault with approximately 8 feet of apparent slip is exposed in the cut slope north of Building 874. Other faults are postulated in the subsurface of the area based on cross sections constructed using seismic data, geophysical logs, and lithologic logs. Fault interpretations are also supported by locally steep gradients on potentiometric surface maps and pump test information. Insufficient information is available at this time to determine the orientation and extent of these faults in the subsurface or of the fault exposed north of Building 874. Nine abundant joints and fractures are present in the Neroly Formation in the GSA and vicinity. Mineral coatings of manganese and iron oxides have been found on fractures in drill core indicating the fractures are a natural phenomenon and not the result of drilling activities. Most fractures observed in drill core occur subparallel to bedding planes in brittle claystone and siltstone and as subvertical joints in resistant, locally cemented sandstone beds. These observations suggest that the more brittle, finer-grained strata may be more responsive to stress. Fossil plants and leaves, typically coated with manganese oxide and lesser iron oxide, may also weaken bedding planes. At deep monitor well W-25N-04, fractures may transport most, if not all, groundwater produced.

Soils—Site 300 Radioactive and Hazardous Waste Management Facilities

Within the Building 883 area, soils consist primarily of the Alo Vaquero complex with the northeast and northwest portion of the area covered by the Wisflat-Arburua-San Timoteo complex. The Alo-Vaquero complex is comprised of clay to silty clay, which is calcareous below 10 inches, typically grading to shale and sandstone at 20 to 40 inches. These soils are well-drained with relatively low permeability and low water-holding capacity. Runoff from Alo-Vaquero soils is medium to rapid, and erosion hazards are moderate to severe. Excessive shrinking and swelling of these soils may occur. The Wisflat-Arburua-San Timoteo complex soils consist of well- to very well-drained sandy to clayey loam with moderate to moderately high permeability and low to very low water-holding capacity. Runoff from these soils is high, and the erosion hazard is severe.

Seismicity—Site 300 Radioactive and Hazardous Waste Management Facilities

Site 300 is located near the eastern edge of the Coast Range Province, which is characterized by northwest trending, strike-slip faults of the San Andreas Fault system. The boundary between the Coast Ranges and the San Joaquin Valley lies immediately east of Site 300 and is characterized by east-northeast compression, resulting in reverse and thrust faulting and folding. The principal faults in the vicinity of Site 300 are the Corral Hollow-Carnegie, Black Butte, and Midway faults. These faults are further described in Appendix H. The active Carnegie Fault of the Corral Hollow-Carnegie Fault zone crosses the southern portion of the site. No significant recorded earthquakes have occurred on any of the local faults.

B.4.9 Ecology

B.4.9.1 *Vegetation*

The Livermore Site RHWM facilities cover less than 5 percent of the 821-acre site. The vegetation at this site was initially altered in the 1800s when livestock grazing began on a large scale in the Central Valley and surrounding areas of California.

The plant communities at the Livermore Site were further degraded and destroyed when the U.S. Navy acquired the land in 1942 and covered the site with concrete runways, roads, and buildings. In addition, Arroyo Las Positas, which flowed through the site, was channelized and now traverses part of the eastern boundary and flows through the northern part of the site.

A survey was conducted in June 2002, which confirmed that site conditions and species composition have changed relatively little during the past 10 years. The developed areas at the Livermore Site, including areas near Buildings 233 CSU and 280, DWTF, and Areas 514 and 612, are planted with ornamental vegetation and lawns. There are also small areas of disturbed ground with early successional plant species. The undeveloped land in the security zone (located north of DWTF) is the introduced grassland plant community dominated by nonnative grasses such as wild oat, brome grasses, foxtail barley, curly dock, and wild radish years (Jones and Stokes 2002a).

Plant species along Arroyo Las Positas (located north of the DWTF) were observed to be essentially those found during a 1997 survey. Common species in the annual grassland along the upper channel bank of the arroyo include wild oats, brome grasses, alkali mallow, and yellow star-thistle (Jones and Stokes 2002a, 2002c).

Site 300 covers approximately 7,000 acres of land in eastern Alameda County and western San Joaquin County. The northern portion is characterized by rolling hills while the southern part consists of steep, deep canyons. The site was acquired in 1953 and, since then, no grazing or farming has taken place. A relatively small part (approximately 5 percent) has been developed for all LLNL activities (less than one percent are waste management-related); the remainder is undisturbed, except for controlled burning. Controlled burning takes place every year on approximately 2,000 acres of land, including areas surrounding the EWTF. Approximately 620 acres of formerly designated California red-legged frog habitat is located in the southwestern half of Site 300. Both the EWSF and Building 883 are located in this area. A 385-acre area including formerly designated as Alameda whipsnake critical habitat is located in the

southwestern quarter of Site 300. None of the Site 300 waste management facilities are located in the area (Jones and Stokes 2001, USFWS 2002a).

Several site-wide vegetation surveys have been conducted at Site 300. These surveys have identified a total of 406 plant species at this site (Jones and Stokes 2002a).

B.4.9.2 *Fish and Wildlife*

A total of 4 species of fish, 6 species of amphibians and reptiles, 52 species of birds, and 10 species of mammals were reported observed at the Livermore Site during the biological survey for the 1992 LLNL EIS/EIR or in subsequent documentation (LLNL 1992a, USFWS 1998, LLNL 2003bz).

Wildlife includes species that live in the undeveloped grassland and species that live in the developed areas or along the arroyo (north of DWTF). Representative species observed in the undeveloped grassland areas include the fence lizard, the black-tailed hare, the California ground squirrel, the red fox, and the western meadowlark. Nesting birds include the American crow, American robin, house finch, mockingbird, and house sparrow. These species nest in the planted trees onsite (in the vicinity of all waste management facilities). A raven's nest was observed among some pipes at the Livermore Site.

Recent studies have provided new information about raptor activity at the Livermore Site. In 1996, the red-shouldered hawk, not previously known to occur on LLNL property, nested at the Livermore Site (LLNL 1997e). In 1999, 3 pairs of nesting white-tailed kites, a state-protected bird of prey, successfully fledged 18 young at the Livermore Site. The kites were marked with aluminum leg bands to initiate long-term studies of the species in a semi-urban edge habitat (DOE 2001a, LLNL 2001v).

Site 300, with large areas of undisturbed vegetation, interspersion of various plant community types, and availability of water at springs, provides habitat for a diversity of wildlife. A total of 20 amphibian and reptile species have been observed at Site 300. The scarcity of permanent water limits the potential of Site 300 to support more than a few species of amphibians. Aquatic habitat is available at the sewage lagoon (located east of Building 883) and some of the drainages contain aquatic vegetation supported by underground springs and seeps. Two species of salamanders were observed: the California slender salamander and the California tiger salamander. The latter species was observed during 1986 biological surveys, but not during 1991 surveys. Frog and toad species known to occur onsite are the western toad, Pacific treefrog, and California red-legged frog.

Conditions are far more favorable for reptiles than for amphibians at Site 300. Grassland provides ideal habitat for racers and gopher snakes. Rock sites provide suitable habitat for such species as the western fence lizard, western skink, common kingsnake, and the western rattlesnake. Seeps and springs provide excellent habitat for the northern alligator lizard. Side-blotched lizards and California horned lizards frequent areas with more open vegetation and sandy soils.

A total of 90 bird species have been observed at Site 300 in 2002 (LLNL 2003by). Although grasslands normally support a limited resident bird population, the Site 300 interspersion of several different plant community types and an abundance of seeds and insects provide good habitat for a variety of birds. The western meadowlark, horned lark, and savannah sparrow were the most common small birds seen throughout the open grassland areas. Vegetation at springs and seeps provides nesting habitat for the red-winged blackbird. These permanent water sources attract a greater number of birds than normally found in the adjacent grasslands. For example, mourning dove, cliff and barn swallow, and California quail all require daily water. Oak woodland and a few cottonwood provide nesting habitat for the western kingbird, northern oriole, loggerhead shrike, and American goldfinch. Coastal sage scrub supports scrub jay, Anna's hummingbird, rufous-crowned sparrow, and white-crowned sparrow. Ecotones (boundary areas between two habitats) of sage scrub and grassland provide ideal habitat for mourning dove, California quail, lazuli bunting, and lark sparrow. Rocky outcrops and cliffs provide breeding sites for white-throated swift, cliff swallow, Say's phoebe, and rock wren. Site 300 supports a population of nesting raptors. A report is in progress to provide the current status of foraging and nesting activities of such raptors as the great horned owl, barn owl, golden eagle, prairie falcon, red-tailed hawk, northern harrier, and short-eared owl.

A total of 30 mammal species have previously been observed onsite. Mammals were recorded during threatened and endangered species surveys that included ground surveys over the entire site, night spotlighting, establishment of scent stations in 1986 and 1991, and small-mammal trapping in 1986 (LLNL 1992a). An inventory was recently conducted on small mammals at Site 300, and 10 small mammal species were identified (Jones and Stokes 2002b).

Productive and diverse grasslands on Site 300 support an abundance of rodents and lagomorphs (rabbits and hares). Conditions are ideal for California ground squirrels in the northern portion of Site 300 where the terrain is less rugged. Other common rodents include the house mouse, deer mouse, brush mouse, western harvest mouse, California vole, Heermann's kangaroo rat, San Joaquin pocket mouse, California pocket mouse, and valley pocket gopher (Jones and Stokes 2002b). Lagomorphs such as black-tailed hares and desert cottontails are also widespread and abundant, with the latter tending to occupy areas with more cover.

B.4.9.3 *Threatened and Endangered Species*

Detailed studies for threatened, endangered, and other species of concern (referred to as sensitive species in this section) were conducted at the Livermore Site and Site 300. Other species of concern refer to Federal candidate species and State of California species of special concern. The biological assessment currently under regulatory agency informal consultation includes a list of potential sensitive species that may occur at the sites. As a result of recent surveys and previous consultations, six federally listed species and two state-listed species have been identified at or near Site 300.

No sensitive plants, invertebrates, reptiles, or mammals were observed during the 1992 or recent biological surveys at the Livermore Site (LLNL 1992a, USFWS 2002a). The California red-legged frog, a federally listed threatened species and a State species of special concern occurs at the Livermore Site.

Although the U.S. Fish and Wildlife Service (USFWS) established critical habitat for the species in March 2001 (66 FR 14626), the critical habitat was later rescinded by a court order. At the Livermore Site, formerly designated critical habitat for the California red-legged frog is present in the North Buffer Zone, just north of the DWTF (LLNL 2002cc). It is possible that the USFWS will later re-establish the critical habitat.

Although the California tiger salamander, a federally proposed threatened species and state species of special concern, is not presently found at the Livermore Site, it has been observed in land near the installation (LLNL 1992a, LLNL 2002cc). The DWTF and Areas 514 and 612 are located adjacent to formerly designated critical habitat for the California red-legged frog.

The loggerhead shrike, a Federal species of concern and a State species of special concern, has recently been reported nesting in developed areas at SNL/CA (NNSA 2003a).

The only federally protected plant species known to occur at Site 300 is the large-flowered fiddleneck (a federally listed and state-listed endangered species). A portion of Site 300 has been designated as critical habitat for the plant (Jones and Stokes 2002c). None of the RHWM facilities are located in this area.

B.4.9.4 *Wetlands*

Wetlands, although very limited at the Livermore Site, do occur along Arroyo Las Positas at the northern perimeter of the site, adjacent to the DWTF. In 1992, 0.36 acre was determined to qualify as jurisdiction wetland. The wetland was dominated by salt grass, and cattails occurred on one-third of the wetland (LLNL 1992a, Jones and Stokes 2002c).

Since 1992, wetlands along Arroyo Las Positas have increased due to the release of water associated with environmental restoration activities at the Livermore Site. In 1997, an additional wetland delineation study was performed along Arroyo Las Positas. That study determined that the size of jurisdictional wetlands had expanded to approximately 1.96 acres and involved three different wetland plant communities. Approximately 1.22 acres of ruderal wetland was identified dominated by tall flatsedge, bristly ox-tongue, bearded sprangletop, Bermuda grass, and barnyard grass (Jones and Stokes 2002c).

Approximately 0.65 acre of freshwater marsh was delineated dominated by cattails and bullrushes. Finally 0.09 acre of riparian scrub was observed dominated by willows and a small stand of cottonwoods (Jones and Stokes 2002c).

A study for the EIS for previous site-wide operations delineated 6.76 acres of wetlands at Site 300 (LLNL 1992a). In August 2001, another wetland delineation study was conducted identifying 46 wetlands and determining that the total size of wetlands had increased to 8.61 acres. Approximately 4.39 acres were found to meet criteria for jurisdictional wetlands. These wetlands are small in nature and include freshwater seeps, runoff from some of the buildings, vernal pools, and seasonal ponds (Jones and Stokes 2002c). Many of the wetlands occur at springs in the bottom of deep canyons in the southern half of the site. RHWM facilities are associated with wetlands at either the Livermore Site or Site 300.

B.4.10 Air Quality

Radiological air quality is discussed below. The section provides radionuclide emission estimates as well as dose calculations for maximally exposed receptors and the populace. Dose estimates are also compared to EPA standards designed to protect members of the public.

Section B.4.10.2 details LLNL's air pollutant sources and emissions. While both LLNL sites are discussed, focus is weighted more heavily on the Livermore Site because it is significantly larger in terms of the number of sources, permitted equipment, emission rates, and employee traffic.

B.4.10.1 *Radiological Air Emissions*

LLNL uses and manages a variety of radioisotopes, including uranium, TRUs, biomedical tracers, tritium, and mixed-fission products and waste, for research purposes. The major radionuclide released to the atmosphere from the Livermore Site is tritium. In addition to effluent sampling for tritium, a number of facilities at the Livermore Site (including the DWTF and Building 514) have air effluent samplers to detect the release of uranium and TRU aerosols. LLNL also monitors diffuse, or nonpoint, sources to fulfill the National Emission Standard for Hazardous Air Pollutants (NESHAP) requirements. Summary data from several point and diffuse sources can be found below. Assessment of air effluent emissions and resulting dose to the public is performed by monitoring emissions and/or evaluating potential emissions. Radiological emissions from LLNL RHWM facilities, LLNL operational facilities, and other sources and subsequent exposure to members of the public are considered minor (LLNL 2002bb).

For the Livermore Site, the dose calculated for the site-wide maximally exposed individual (MEI) from diffuse emissions in 2001 totaled 0.011 millirem. The dose due to point sources was 0.0056 millirem. When combined, the total annual dose was 0.017 millirem, 66 percent from diffuse and 34 percent from point sources. The total dose to the Site 300 site-wide MEI from operations in 2001 was 0.054 millirem. Point source emissions from firing table explosives experiments accounted for 0.050 millirem, or 93 percent, of this total, while 0.0037 millirem, or about 7 percent, was contributed by diffuse sources containing low levels of depleted uranium, representing resuspension by wind of soil throughout the site.

Tritium accounted for more than three-quarters of the Livermore Site's calculated dose, while at Site 300, practically the entire calculated dose was due to the isotopes uranium-238, uranium-235, and uranium-234 in depleted uranium. LLNL doses from air immersion and ground irradiation are negligible for both tritium and uranium.

Table B.4.10.1–1 shows the facilities or sources (four of the eight are RHWM facilities) that accounted for more than 90 percent of the doses to the site-wide MEI for the Livermore Site and Site 300 in the year 2001. Although LLNL has nearly 200 sources releasing radioactive material to the air, most are very minor; nearly the entire radiological dose to the public comes from fewer than a dozen sources. The trends in dose to the site-wide MEI from emissions at the Livermore Site and Site 300 over the last 12 years are shown in Table B.4.10.1–2. The general pattern, particularly over the last decade, shows year-to-year fluctuations around a quite low dose level, staying at or below about 1 percent of the Federal standard.

The site-wide MEI dose estimates are intentionally conservative, predicting potential doses that are generally higher than would actually be experienced by any member of the public.

TABLE B.4.10.1–1.—*List of Facilities or Sources Whose Emissions Accounted for More Than 90 Percent of the Site-wide Maximally Exposed Individual Doses for the Livermore Site and Site 300 in 2001*

Facility (source category)	CAP88-PC dose in mrem/y[a]	CAP88-PC percentage contribution to total dose
Livermore Site		
Building 612 Yard (diffuse source) [b]	0.0082[a]	48
Building 331 Stacks (point source)	0.043[a]	25
Building 514 Tank Farm (diffuse source)[b, c]	0.0013	8
Southeast Quadrant (diffuse source)	0.00088	5
Building 612, (point source) [b]	0.00062	4
Building 514 Evaporator (point source) [b, c]	0.00058	3
Site 300		
Building 851 Firing Table (point source)	0.05	93
Soil resuspension (diffuse source)	0.0037	7

Source: LLNL 2002cc.
[a] One mrem equals 10 microsievert.
[b] RHWM facility.
[c] This source moves to the DWTF prior to FY2005.
DWTF = Decontamination and Waste Treatment Facility; RHWM = radioactive and hazardous waste management.

TABLE B.4.10.1–2.—*Doses Calculated for the Site-wide Maximally Exposed Individual for the Livermore Site and Site 300, 1990 to 2001*

Year	Total dose (mrem)[a]	Point source dose (mrem)[a]	Diffuse source dose (mrem)[a]
Livermore Site			
2002	0.23[b]	0.10[b]	0.13
2001	0.017[b]	0.0057[b]	0.011
2000	0.038[b]	0.017[b]	0.021
1999	0.12[b]	0.094[b]	0.028
1998	0.055[b]	0.031[b]	0.024
1997	0.097	0.078	0.019
1996	0.093	0.048	0.045
1995	0.041	0.019	0.022
1994	0.065	0.042	0.023
1993	0.066	0.04	0.026
1992	0.079	0.69	0.01
1991	0.234	(c)	(c)
1990	0.24	(c)	(c)
Site 300			
2002	0.021	0.018	0.0033
2001	0.054	0.05	0.0037
2000	0.019	0.015	0.0037
1999	0.035	0.034	0.0012
1998	0.024	0.019	0.005
1997	0.02	0.011	0.0088
1996	0.033	0.033	0.00045
1995	0.023	0.02	0.003
1994	0.081	0.049	0.032
1993	0.037	0.011	0.026
1992	0.021	0.021	(d)
1991	0.044	0.044	(d)
1990	0.057	0.057	(d)

Source: LLNL 2003l.

[a] One mrem equals 10 microsievert (μSv).

[b] The dose includes modeling tritium emissions as directed by EPA Region IX. EPA Region IX acknowledges that such modeling results in a conservative overestimation of the dose. This methodology is used for purposes of compliance.

[c] Diffuse source doses were NR separately from the total dose for the Livermore Site for 1990 and 1991.

[d] No diffuse emissions were reported at Site 300 before 1993.

Common Radiological Effect Terminology

Dose: the energy imparted to matter by ionizing radiation; the unit of absorbed dose is the rad, equal to 0.01 joules per kilogram for irradiated material in any medium.

Diffuse source: any unconfined area (e.g., entire building or yard, ground, large tank, or evaporator).

Effective dose equivalent (EDE): an estimate of the total risk of potential effects from radiation exposure, it is the summation of the products of the dose equivalent and weighting factor for each tissue. The weighting factor is the decimal fraction of the risk arising from irradiation of a selected tissue to the total risk when the whole body is irradiated uniformly to the same dose equivalent. These factors permit dose equivalents from non-uniform exposure of the body to be expressed in terms of an effective dose equivalent (EDE) that is numerically equal to the dose from a uniform exposure of the whole body that entails the same risk as the internal exposure (ICRP 1990). The EDE includes the committed EDE from internal deposition of radionuclides and the EDE caused by penetrating radiation from sources external to the body, and is expressed in units of rem (or sievert).

Maximally exposed individual (MEI): a hypothetical member of the public at a fixed location who, over an entire year, receives the maximum EDE (summed over all pathways) from a given source of radionuclide releases to air. Generally, the MEI is different for each source at a site.

Point source: any confined and discrete conveyance (e.g., pipe, ditch, well, or stack).

Rem: a unit of radiation dose equivalent and EDE describing the effectiveness of a type of radiation to produce biological effects; coined from the phrase "roentgen equivalent man," and the product of the absorbed dose (rad), a quality factor (Q), a distribution factor, and other necessary modifying factors. One rem equals 0.01 sievert.

Sievert (Sv): the international unit of radiation dose equivalent and EDE, that is the product of the absorbed dose (gray), quality factor (Q), distribution factor, and other necessary modifying factors. 1 Sv equals 100 rem.

Site-Wide Maximally Exposed Individual (MEI): a hypothetical person for each LLNL location (Livermore Site and Site 300) who receives, at the location of a given publicly accessible facility (such as a church, school, business, or residence), the greatest LLNL-induced EDE (summed over all pathways) from all sources of radionuclide releases to air at a site. Doses at this receptor location caused by each emission source are summed, and yield a larger value than for the location of any other similar public facility. This individual is assumed to continuously reside at this location 24 hours per day, 365 days per year.

B.4.10.2 *Nonradiological Air Emissions*

All LLNL activities with the potential to produce air pollutant emissions are evaluated to determine the need for air permits and assess continued compliance. Sources that have been determined to be exempt from permit requirements are monitored to substantiate that each source operates in agreement with exemption specifications (e.g., throughput remains within the limits of a specified exempt quantity).

In 2002, LLNL operated 199 air emission sources for the Livermore Site and 44 air emission sources for Site 300. Air emission source permits are listed in the RCRA Part B Permit and include waste operations in Building 612, Building 514 and the EWTF. A general listing of air permits is provided in Table B.4.10.2–1.

TABLE B.4.10.2–1.—*Summary of Air Permits Active in 2002*

Category	Permitted Units	
	Livermore Site	**Site 300**
Coating, printing, and adhesives	Paint spray booths Adhesives operations Optic coating operations Printing press operations Silk-screening operations Silk-screen washers	Paint spray booth
Combustion	Boilers Emergency generators Diesel air-compressor engines	Boilers Emergency generators
Explosives testing	Fire test cells and firing tanks	Contained Firing Facility
Gasoline dispensing	Gasoline dispensing operation	Gasoline dispensing operation
Machining	Metal machining and finishing operations	-
Ovens	Ovens	Drying ovens
Remediation	Groundwater air strippers/dryers	Groundwater air strippers Soil vapor extraction units
Materials handling	Drum crusher Paper-pulverizer system	Woodworking cyclone (exhaust system control device)
Solvent cleaning	Cold cleaners Manual wipe-cleaning operations	-
Miscellaneous	Oil and water separator Sewer diversion system Storage tanks with VOCs in excess of 1.0% Semiconductor operations Material-handling equipment	Explosive waste treatment units
Total Permitted Units	**199**	**44**

Source: LLNL 2003l.
RHWM = radioactive and hazardous waste management; VOC = volatile organic compound.

Site-wide criteria pollutant emission rates for LLNL are provided in Table B.4.10.2–2. The Livermore Site currently emits approximately 90 kilograms per day of criteria air pollutants from both permitted and exempt sources. The largest sources of criteria pollutants from the Livermore Site are surface coating operations, internal combustion engines, solvent operations, and oil and natural gas-fired boilers. The largest sources at Site 300 are internal combustion engines, boilers, a gasoline-dispensing operation, open burning of brush for fire hazard management, paint spray booths, drying ovens, and soil vapor extraction operations (LLNL 2002cc).

Finally, a separate Federal listing of approximately 200 compounds is evaluated to confirm applicability under NESHAP. Emission rates at both LLNL sites are less than one-half of the thresholds of 7 tons per year for a single hazardous air pollutant (HAP) or 15 tons per year for a combination of HAPs (LLNL 2002e).

TABLE B.4.10.2–2.—*Criteria Air Pollutant Emission Rates*

	Estimated Releases (kilograms per day) [a]									
	Livermore Site					Site 300				
Pollutant	**1998**	**1999**	**2000**	**2001**	**2002**	**1998**	**1999**	**2000**	**2001**	**2002**
Precursor organic compounds	25	24	20	19	16	0.90	1.2	0.4	0.1	0.23
Nitrogen oxides	56	81	54	52	67	2.1	3.2	2.3	0.9	1.1
Carbon monoxide [b]	11	24	14	14	17	0.48	0.71	0.5	1.1	1.0
Particulates (PM_{10})	5.7	8.6	5.5	5.5	6.1	0.53	0.33	0.2	0.3	0.09
Oxides of sulfur	0.72	0.98	0.6	0.6	2.8	0.15	0.28	0.2	0.1	0.07

Source: LLNL 2002cc, LLNL 2001v, LLNL 2000g, LLNL 1999c, LLNL 2003l.
[a] One kilogram equals 2.2 pounds.
[b] In 1999, the emission factor used to calculate carbon monoxide was 0.035 pounds per 1,000 cubic feet for large boilers and 0.021 pounds per cubic foot for small boilers. In previous years the emission factor used was 0.017 pounds per cubic foot for both large and small boilers. This resulted in a significant change in carbon monoxide emissions reported for 1999.
PM_{10} = particulate matter less than 10 microns diameter.

Based on previous assessments, the Bay Area Air Quality Management District and the San Joaquin Valley Unified Air Pollutant Control District have ranked LLNL as a low-risk facility for nonradiological air emissions.

B.4.11 Water Resources and Hydrology

Surface Water

Surface drainage and natural surface infiltration at the Livermore Site are generally good, but drainage decreases locally with increasing clay content in surface soils. Surface flow may occur intermittently from October to April, during the valley's wet season. The two major intermittent streams associated with the Livermore Site are the Arroyo Seco and Arroyo Las Positas; the latter is located north and adjacent to the DWTF. When surface flow occurs in these channels, water infiltrates into the underlying alluvium and eventually percolates to the aquifers.

Arroyo Seco cuts across the southwestern corner of the site, flowing to the northeast; discharge to this stream is primarily storm runoff. Arroyo Las Positas is an intermittent stream that drains from the hills directly east of the Livermore Site. This channel enters the Livermore Site from the east, is diverted along a storm ditch around the northern edge of the site, and exits the site at the northwest corner.

Nearly all surface water runoff at the Livermore Site is discharged into Arroyo Las Positas; only surface runoff along the southern boundary and storm drains in the southwest corner of the Livermore Site drain into Arroyo Seco.

Surface water at Site 300 consists of seasonal runoff, springs, and natural and manmade ponds. There are no perennial streams at or near Site 300. The canyons that dissect the hills and ridges at Site 300 drain into intermittent streams. Naturally occurring springs show both the presence of flowing water or wet soils where the water table at that point is close to the surface, and the presence of distinct hydrophytic vegetation (cattails, willow). There are at least 23 springs at Site 300, 19 that are perennial and 4 that are intermittent. Most of the springs have very low flow rates and are recognized only by small marshy areas, pools of water, or vegetation.

Numerous artificial surface water bodies are present at Site 300. Several areas of surface water discharge are present onsite near cooling towers or other process runoff areas. These artificial runoff areas have the same characteristics as natural springs because they contain running water and support hydrophytic vegetation (LLNL 2002k).

Surface Water-Radioactive and Hazardous Waste Management Facilities

For waste management areas that are not completely enclosed, accumulated precipitation must be removed from the secondary containment systems as required to prevent overflow. (Note: Puddles of rainwater that do not exceed a depth of a half-inch do not interfere with operations, do not compromise secondary containment capacity, are not removed, and are allowed to evaporate.) In general, the accumulated liquids are managed based on volume accumulated and analytical results when samples are required to be collected. The accumulation points (i.e., sumps and trenches) are typically visually inspected to determine if liquids are present. If liquids are observed or detected, the source (e.g., precipitation) of the liquids is determined. If analytical results are within the discharge limitations, the accumulated liquids are discharged. If the analytical data indicate that the accumulated liquid does not meet sanitary sewer discharge criteria, the liquids are removed using a wet-dry vacuum, portable pump, or similar collection device and transferred into appropriate containers. The contaminated liquids are then managed as a waste.

In one area of the Area 612 yard, gravity drain lines are used to drain the accumulated rainwater directly into the sanitary sewer. A normally closed and locked isolation valve is located on the drain line to prevent unauthorized discharges.

Discharges to the Sanitary Sewer

Prior to any discharge to the sanitary sewer, wastewater must be tested and found to meet or fall below internal discharge limits. Further treatment of the wastewater is conducted as necessary to meet discharge requirements. Once the wastewater meets these requirements, the RHWM then discharges the wastewater through the discharge ports at the Area 612 facility or the DWTF, which are kept locked and to which only selected personnel have custody of the key. A record of the discharges is kept.

Groundwater

Within the Livermore Valley, uppermost saturated sediments are commonly unconfined. Interbeds and interlenses of low-conductivity sediments within the saturated zone act as local aquitards, which tend to confine the deeper water-bearing zones. The two most important formations that contain groundwater are Quaternary alluvial deposits and the Plio-Pleistocene Livermore Formation. The Livermore Formation is generally of lower permeability than the overlying deposits, but it commonly contains significant water-bearing zones.

In general, groundwater flows toward the east-west longitudinal axis of the Livermore Valley and then in a westward direction to the gravel pit mines and the municipal water supply wells near Livermore and Pleasanton. Vertical movement of water between the lower member of the Livermore Formation and the overlying alluvial sediments is restricted by permeability differences and by internal stratification within these sedimentary units. At the Livermore Site, the upper 15 to 60 feet of the lower member of the Livermore Formation is known to act as an

aquitard. Under the Livermore Site, the contact between distinctively colored units in the lower member of the Livermore Formation generally dips to the west and is found between approximately 25 and 400 feet below ground surface.

The Livermore Valley has been divided into several groundwater subbasins. The Livermore Site is located within the Spring and Mocho I subbasins. Groundwater leaves the Spring-Mocho I sub-basin through surface discharge at the Las Positas Spring located near Interstate Highway 580 and State Highway 84 (1.5 miles northwest of LLNL) and via westward subsurface flow into the Mocho II subbasin. The Las Positas Fault Zone forms the southern boundary of the Spring-Mocho I subbasin. South of the Livermore Site, the water levels on the south side of the Las Positas Fault Zone have been more than 80 feet higher than those on the north side of the fault. This water level differential indicates that the Las Positas Fault Zone forms a significant barrier to groundwater flow.

Groundwater ranges from excellent to poor quality and has been used for industrial, agricultural, and domestic purposes. A Federal Facility Agreement for the Livermore Site was signed in November 1988 prohibits LLNL from using the underlying groundwater for drinking water. The LLNL area groundwater locally recharges by percolation through the valley alluvium and by infiltration via Arroyo Seco and Arroyo Las Positas as well as from unlined drainage ditches. A recharge basin (located south of the Livermore Site) is a significant source of groundwater recharge. The basin receives treated groundwater from the southwest portion of the Livermore Site. A manmade drainage retention basin (located near the center of the Livermore Site) has been lined to prevent the infiltration of stormwater and treated groundwater from proposed groundwater extraction well locations.

The depth to the water table beneath the Livermore Site currently ranges from approximately 30 feet to 135 feet. Periodic water table changes and mounds have been observed due to groundwater recharge near the Arroyo Seco, the Arroyo Las Positas, and the central drainage retention basin.

Water level fluctuations in monitoring wells near the Area 612 facility, the DWTF complex, and the Building 280 facility have been observed since 1985 and 1997. Some seasonal fluctuations can be observed. A rather steep water table gradient is observed near the DWTF complex. This steep gradient may be due to the abundance of low-permeability sediments in this area and to local recharge adjacent to the Arroyo Las Positas.

At Site 300, two regional aquifers or major water-bearing zones have been identified: an upper water table aquifer in the sandstones and conglomerates of the Neroly Formation and a deeper confined aquifer located in Neroly sandstones just above the Neroly/Cierbo contact. Both aquifers have permeable zones layered with lower permeability claystones, siltstones, or tuffs. Many of the sandstones are fine-grained and silty and contain fractures. Groundwater flow is both intergranular and fracture flow. In addition to the two regional aquifers, several perched aquifers have been identified, some of which give rise to springs. Extensive perched aquifers are present beneath the northwestern portion of the site and in the southeastern portion of the site. In addition, shallow Quaternary alluvium and undifferentiated Tertiary nonmarine sediments are locally water bearing such as the GSA. These local aquifers are generally unconfined or water table aquifers.

Investigation and remediation of contaminated groundwater beneath the Livermore Site and Site 300 is ongoing. Volatile organic compounds (VOCs) and other contaminants of concern are present in groundwater. Areas of past releases of contaminants to the environment, some dating from the 1940s, have been identified and groundwater contamination is being treated. Concentrations of contaminants have been significantly reduced as a result of extracting and treating millions of gallons of water.

A total of 862 solid waste management units at LLNL are identified and delineated in the EPA RCRA Facility Assessment, Visual Site Inspection Report. Investigation and resolution of groundwater contamination at the Livermore Site is being addressed according to the schedules and details specified in the Federal Facility Agreement. Investigation and resolution of groundwater contamination at Site 300 is being addressed as eight operable units. None of the storage or treatment units in this appendix are expected to impact the groundwater under the Livermore Site.

A wide range of analytes is monitored to assess the impact, if any, of current LLNL operations on local groundwater resources. Because surveillance monitoring is geared to detecting substances at very low concentrations in groundwater, it can detect contamination before it significantly impacts groundwater resources. Wells at the Livermore Site, in the Livermore Valley, and at Site 300 in the Altamont Hills are included in LLNL's surveillance monitoring plan. Initial releases of hazardous materials occurred at the Livermore Site in the mid-to-late 1940s when the site was the Livermore Naval Air Station. There is also evidence that localized spills, leaking tanks and impoundments, and landfills contributed VOCs, fuel hydrocarbons, lead, chromium, and tritium to the groundwater and unsaturated sediment in the post-Navy era. Historically, the surveillance and compliance monitoring programs have detected relatively elevated concentrations of various metals, nitrate, perchlorate, and depleted uranium (uranium-238) in groundwater at Site 300. Subsequent *Comprehensive Environmental Resources, Compensation, and Liability Act* (CERCLA) studies have linked several of these contaminants, including uranium-238, to past operations, while other contaminants are the objects of continuing study. Present-day administrative, engineering, and maintenance controls at both LLNL sites are specifically tailored to prevent accidental releases of chemicals to the environment.

Floodplains

All waste management units are located outside the predicted 100-year floodplain areas. The 100-year floodplains are adjacent to Arroyo Seco and Arroyo Las Positas, which are approximately 52 feet from the nearest waste management unit. LLNL stormwater is channeled through storm drains designed to accommodate a 10-year flow. At RHWM facilities, rainwater is collected, sampled, and disposed of according to the chemical analysis. Open ditches are used in underdeveloped areas of the Livermore Site. The Arroyo Seco crosses the Livermore Site at the southwest corner. The Arroyo Las Positas originally crossed the northeast section of the Livermore Site. However, in 1965, as part of an erosion control program, the Arroyo Las Positas was channeled north to the northeast corner of the Livermore Site, and then west along the north perimeter to an outlet near the northwest corner. This outlet, which also constitutes the main pathway for the Livermore Site surface drainage (storm and irrigation), runs north to the Western Pacific tracks, then west where it joins Arroyo Seco.

There are no floodplains on Site 300 as the 100-year base flood event is contained within all channels.

B.4.12 Noise

The noise generated at LLNL is typical of an R&D facility. Ambient noise sources include onsite vehicular traffic and stationary noise sources such as generators, cooling systems, transformers, engines, pumps, fans, etc. Construction activities also contribute to ambient background noise levels.

EPA guidelines for environmental noise protection recommend an average day-night sound level of 55 A-weighted decibels (dBA) as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas. Land-use compatibility guidelines adopted by the Federal Aviation Administration (FAA) and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses, and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (14 CFR Part 150).

LLNL is not subject to environmental noise regulation by state or local agencies. Alameda County has noise standards for the unincorporated areas of the county, which are applicable to areas northeast, east, south (beyond SNL/CA), and southeast of the Livermore Site. The standards correlate types of land use with minutes of exposure to various dB(A) levels by time of day. Noise sources associated with construction are exempt from the noise standards, provided the construction activities do not take place before 7 a.m. or after 7 p.m., Monday through Friday, or before 8 a.m. or after 5 p.m., Saturday or Sunday. Table B.4.12–1 presents the Alameda County noise level standards.

TABLE B.4.12–1.—*Alameda County Noise Level Standards*

Cumulative Number of Minutes in any 1-Hour Time Period	Noise Level Standard (dBA)			
	7 a.m. to 10 p.m.		10 p.m. to 7 a.m.	
	Noise Sensitive[a]	Commercial	Noise Sensitive[a]	Commercial
30	50	65	45	60
15	55	70	50	65
5	60	75	55	70
1	65	80	60	75
0	70	85	65	80

Source: NNSA 2003a.
[a] Noise-sensitive land uses include residences, schools, hospitals, churches, and public libraries.
dBA = A-weighted decibels.

The city of Livermore follows the Noise element of the Livermore General Plan. These guidelines are applicable to areas within the city that are west and northwest of the Livermore Site.

LLNL is subject to occupational noise exposure standards established in a Hearing Conservation Program that incorporates the requirements identified in DOE O 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees," and 29 CFR §1910.95, "Occupational Noise Exposure." The program also incorporates the threshold limit values established by the American Conference of Governmental Industrial Hygienists. Under the Hearing Conservation Program, hearing protection is provided to workers to attenuate exposure to an 8-hour time-weighted average of no more than 85 dBA.

A field survey was conducted in January 2003 to characterize typical daily maximum noise levels in the vicinity of the Livermore Site. Measurements were taken for 1-hour periods using standard sound-level meters during the heart of the morning and evening commute. The monitors were placed at eight locations surrounding and just outside the Livermore Site perimeter and in regions of maximum activity (intersections and site entrance and exit locations), shown in Figure B.4.12–1. Results of the survey, shown in Table B.4.12–2, found that, as expected, vehicular traffic was the dominant noise source at most monitored locations. Rail operations and light aircraft overflights were minor contributors. The only recognizable noise sources from site activities within the site were some heavy equipment backup warning beepers, which were detectable during low traffic intervals at the monitoring sites on Patterson Pass Road. All levels were within the acceptable range established by the city of Livermore and county of Alameda.

The noise generated at Site 300 is typical of an R&D facility with two special considerations: a live firing range and occasional open detonation events (including at the EWTF). Ambient noise sources include onsite vehicular traffic and stationary noise sources such as generators, cooling systems, transformers, engines, pumps, and fans. Construction activities also contribute to ambient background noise levels. Like the Livermore Site, Site 300 is not subject to environmental noise regulation by state or local agencies. Because Site 300 is part of LLNL operations, the occupational noise protection procedures are the same for identifying, handling, protecting, reducing, and controlling noise. The potential for a noise pulse event exists as the EWTF conducts open burns and open detonation to treat explosive wastes. Table B.1.2–1 provides quantity limits at the EWTF.

A less extensive field survey, consisting of five perimeter locations and 10- to 15-minute collection periods, was conducted in the vicinity of Site 300 in 1991, to document weekday ambient noise levels. The study showed that the ambient noise levels along Corral Hollow Road/Tesla Road ranging from 56 to 66 dBA equivalent-continuous sound level (L_{eq}), which is typical of traffic noises associated with suburban-street to near-freeway traffic (Table B.4.12–3).

At the time of the survey, no noticeable noise was being generated at the Site 300 firing range or the Carnegie State Vehicular Recreational Area. Higher ambient noise levels would be expected at the monitoring sites along Corral Hollow Road/Tesla Road during weekend periods when the Carnegie State Vehicular Recreational Area has the greatest off-highway vehicle activity. This survey was performed in 1991.

TABLE B.4.12–2.—*Results of Ambient Noise Measurements*[a]

Locations [b]	Date	Start and End Times [c]	1-Hour L_{eq} [d]
1 Patterson Pass Rd: 16 feet from near traffic lane	Jan. 9, 2003	7:00 - 8:00 AM	70.5
		4:30 - 5:30 PM	68.5
2 Patterson Pass Rd: 19 feet from near traffic lane	Jan. 9, 2003	7:00 - 8:00 AM	68.1
		4:30 - 5:30 PM	63.7
3 Greenville Rd: 6.8 feet from near traffic lane	Jan. 7, 2003	7:15 - 8:15 AM	73.0
		4:30 - 5:30 PM	74.0
4 South Vasco Rd: 17 feet from near traffic lane	Jan. 8, 2003	7:00 - 8:00 AM	70.2
		4:30 - 5:30 PM	68.6
	Jan. 9, 2003[e]	7:00 - 8:00 AM	70.2
5 South Vasco Rd: 32 feet from near traffic lane	Jan. 10, 2003	7:15 - 8:15 AM	73.2
		4:30 - 5:30 PM	66.5
6 South Vasco Rd: 43 feet from near traffic lane	Jan. 10, 2003	7:15 - 8:15 AM	73.4
		4:30 - 5:30 PM	69.3
7 Greenville Rd: 21 feet from near traffic lane	Jan. 7, 2003	7:00 - 8:00 AM	72.2
		4:30 - 5:30 PM	73.5
8 Greenville Rd: 11 feet from near traffic lane	Jan. 8, 2003	7:00 - 8:00 AM	72.3
		4:30 - 5:30 PM	72.6

Source: Sculley 2003.

[a] Monitoring was conducted using Larson-Davis Model 820 Type I sound level meters mounted on tripods, about 4 to 5 feet aboveground level. Instruments have a 110-dB dynamic range with a noise floor of about 20 dB(A). Meters were programmed for slow response (8 samples per second, 1 second averaging), A-weighted setting. Weather protection for the body of the meter was provided as necessary using plastic bags or vinyl pouches.

[b] Locations are shown on Figure B.4.12–1.

[c] Meters were started and stopped manually, with 1-minute time histories and 15-minute interval histories collected; interval histories were synchronized to clock hours.

[d] Leq is an energy-averaged noise level for the indicated time period.

[e] Morning noise monitoring at Station # 4 was repeated on January 9, 2003.

dB(A) = A-weighted decibels.

Table B.4.12–3.— *Site 300 Offsite Ambient Noise Measurement Results*

Location	Time	L_{eq} (dB[A])[a]	Description
Along eastern Site 300 boundary	11:15 - 11:30 AM	59	No dominant noise sources
Next to Corral Hollow Road approximately 0.75 mile west of I-580	9:05 - 9:20 AM	60	Ambient noise dominated by earth-moving equipment operating at Corral Hollow landfill (0.5 mile from monitoring site)
Next to Corral Hollow Road approximately 2 miles east of I-580	9:35 - 9:50 AM	56	Ambient noise dominated by overflying hawk
Next to Corral Hollow Road across from Carnegie State Vehicular Recreational Area	12:50 - 1:05 PM	66	Ambient noise dominated by wind and a few vehicles on roadway
Next to Tesla Road approximately 0.5 mile west of Alameda/San Joaquin County Line	1:15 - 1:30 PM	64	Ambient noise dominated by wind and a few vehicles on roadway

Source: LLNL 1992a.

[a] L_{eq} is an energy-averaged noise level for the indicated time period.

B.4.13 Minerals

The potential stone and aggregate resources of the eastern Livermore Valley and western San Joaquin County were assessed in 1987 and 1988. Zones have been established that identify sand, gravel, and stone source areas. The Livermore Site and Site 300 are located in a Mineral Resource Zone 1. Zone 1 is defined as an area where adequate information indicates that no significant mineral deposits are present or that the likelihood of their presence is rare. Within the eastern Livermore Valley, several deposits have been identified as recoverable and marketable resources (LLNL 1992a). According to a report developed by the California Department of Conservation, Division of Mines and Geology, an estimated 3.8 billion tons of aggregate reserves are available within the southern San Francisco Bay region, and the total aggregate reserves available within the Livermore Valley area amount to 676 million tons; however, much of the area is currently developed for other land uses (TtNUS 2003).

Several occurrences of other potentially economically valuable mineral deposits are within a 10-mile radius of the Livermore Site. These include deposits of manganese, chromium, clay, gemstones, pyrite, dimension stone, sand and gravel, and natural gas.

Petroleum and Natural Gas Production

The Livermore oil field just east (10 miles) of the Livermore Site was discovered in 1967 and, to date, is the only oil field in the Livermore-San Ramon Valley area. The Livermore oil field was originally operated by the Hershey Corporation and consisted of 10 producing wells. These wells are located northeast of Livermore Site. Production is primarily from Miocene Cierbo Formation sandstones at depths of 900 to 2,000 feet. In 1992, the Livermore oil field was operated by the American Exploration Corporation. Of the original 10 wells, 5 were producing an average of 7 barrels of oil per day, 1 well was plugged and abandoned, 3 wells were shut in, and 1 well was used for saltwater injection. Reserves were thought to be approximately 132,000 barrels and production was declining (LLNL 1992a). In 2002, the XL Operating Company operated the Livermore oil field. In February 2002, only three wells were producing. No oil or gas exploration is currently being conducted or proposed for the Livermore Valley or in the hills to the east toward Site 300 (CADC 2002).

While Alameda County has no active natural gas wells, the closest field is located approximately 7 miles southwest of the city of Livermore. Contra Costa and San Joaquin counties have 26 and 63 producing gas wells, respectively. The closest gas field is located approximately 15 miles east of the Livermore Site, near the city of Tracy (CADC 2002).

B.4.14 Traffic and Transportation

This section describes current regional and local transportation activities, including descriptions of any highway, rail, air, or marine transportation infrastructure that DOE uses to support waste movements at LLNL.

LLNL's transportation system consists of paved and unpaved roads, pedestrian malls, paved service areas, and paved parking areas. The Livermore Site has 20 miles of roads and Site 300 has 25 miles of paved roads. Site 300 also has approximately 85 miles of unpaved fire trails.

Onsite vehicular traffic is comprised of light trucks, gasoline and electric carts, medium-duty trucks, forklifts, cranes, and other equipment. Delivery trucks are generally routed only to shipping and receiving facilities. Vehicles owned by organizations performing work (such as construction) for the Livermore Site are permitted around the site when necessary for the performance of the work. At Site 300, private vehicles are restricted to the entrance area.

Entrances to the Livermore Site are situated along Vasco Road, East Avenue, and Greenville Road. The primary routes to East Avenue are Vasco Road and Greenville Road. All regional traffic to and from the Livermore Site is via I-580, exiting onto Vasco Road or Greenville Road. The Site 300 entrance is situated on Corral Hollow Road.

The regional transportation network includes the San Francisco Bay Area. Traffic congestion is a growing concern in the Bay Area. The major transportation arteries near LLNL are I-580 and I-680. Major road projects are underway, including an upgrade to the I-580/I-680 interchange in Pleasanton and the addition of high-occupancy-vehicle (HOV) lanes to I-680 south of Pleasanton. Daily traffic volumes average 30,000 vehicles per day between I-580 and Las Positas Road, 26,200 vehicles per day between Las Positas Road and Patterson Pass Road, and 16,600 vehicles per day between Patterson Pass Road and East Avenue along Vasco Road border of the Livermore Site. Based on the Parking Master Plan and Parking Policy, in 2002, LLNL had 7,500 to 8,500 commuter vehicles (15,000 to 17,000 trips) each business day (LLNL 2002bv).

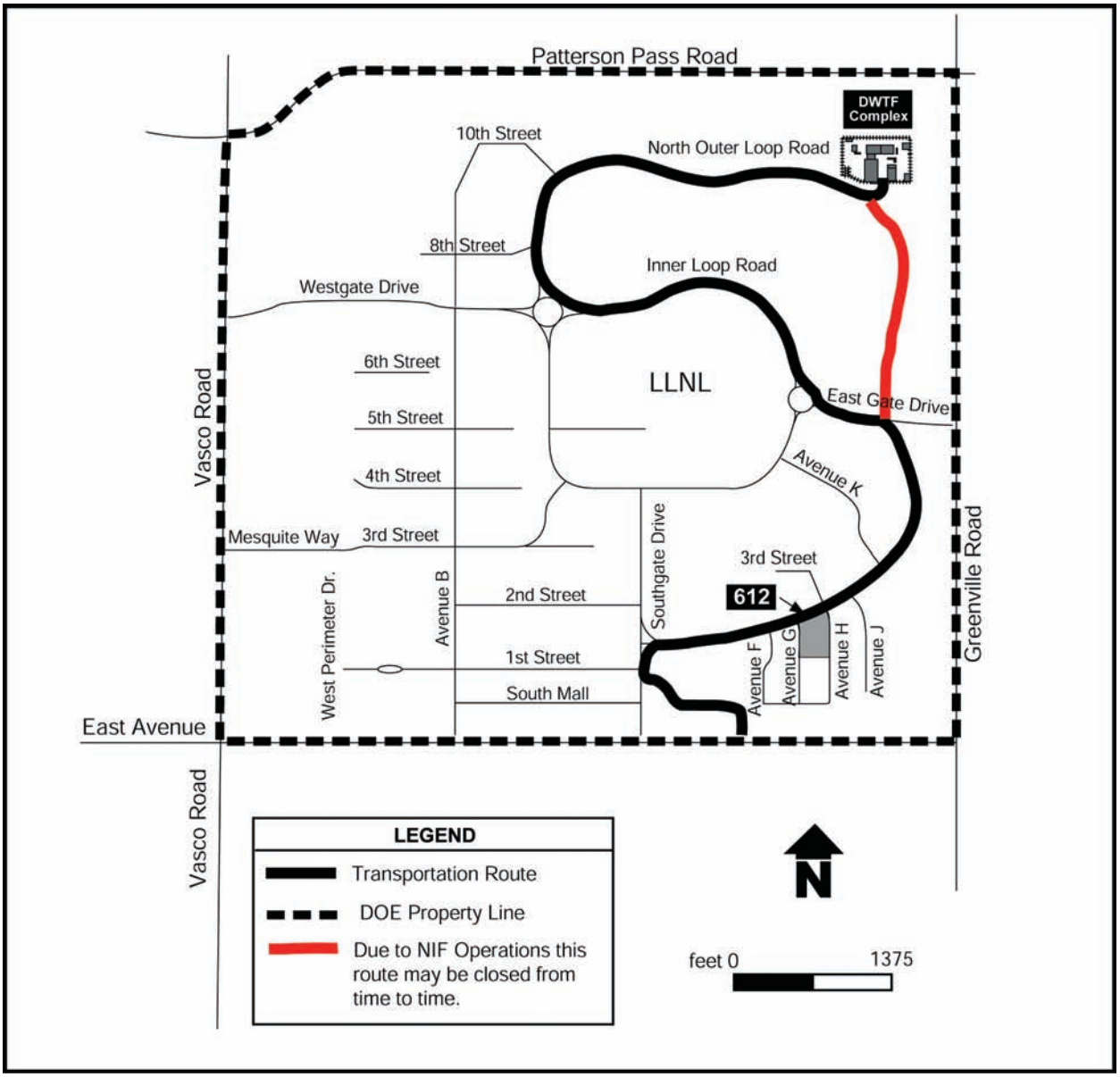
In 2003, LLNL and SNL/CA closed East Avenue as a public street between South Vasco Road and Greenville Road. The closure was prompted by the need for heightened security at the Nation's government facilities. The East Avenue segment is now under administrative control with security checkpoints at both ends of the segment. A truck inspection station is being built west of the Greenville Road intersection.

The East Avenue Gate is used for material and waste shipments. The public closure of East Avenue has not changed the existing transportation route. Figure B.4.14–1 shows the expected onsite waste transportation routes to Area 612 and the DWTF.

The closest airport to the Livermore Site is the Livermore Municipal Airport. This airport is not used for commercial passenger traffic; however, in the past, DOE personnel have flown into this airport using a small government jet. Other small airports in the area are in the cities of Tracy and Byron.

The Livermore Site is served by three international airports for commercial passenger and airfreight services. These airports are San Francisco (approximately 50 miles west), Oakland (approximately 33 miles west), and San Jose (approximately 32 miles southwest).

For Site 300, Tesla Road is an east-west arterial highway located one mile south of the Livermore Site. It is later called Corral Hollow Road at the boundary between Alameda County and San Joaquin County near the western end of Site 300. The access for Site 300 is located on Corral Hollow Road, about 9.3 miles east of Greenville Road. Between Site 300 and Greenville Road, the daily traffic on Tesla Road averages approximately 4,500 vehicles per day. In this area, Tesla Road is a winding two-lane roadway with no paved shoulders; the terrain is rolling. The Livermore Site does not receive any direct traffic by rail although some employees do commute by train, stopping at Vasco Road, approximately 1.5 miles north of the site. LLNL receives no direct traffic by ship.



Source: Original.

FIGURE B.4.14–1.—*Representative Waste Transportation Route Between Area 612 and the DWTF Complex*

Prevailing speeds are about 40 miles per hour. To the east of the Site 300 access, Corral Hollow Road continues as a two-lane winding roadway 6.8 miles to an interchange with I-580 south of the city of Tracy.

B.4.14.1 *Material Shipments*

From 270 to 300 shipments arrive at LLNL per year from offsite vendors (Table B.4.14.1–1). The shipment sizes vary with the frequency and urgency of the need for a particular shipment.

TABLE B.4.14.1–1.—*LLNL Current Annual Material Transportation Activities*

Activity	No. of Shipments
Material (annual shipments of radioactive, chemical, and explosives)	470 shipments[a]
Waste (annual shipments includes hazardous and radioactive)	88 shipments[b]
Annual sanitary waste shipments	518 shipments[c] (7 to 10 per week)

Source: TtNUS 2003.
[a] Based on 2002 data.
[b] Based on 1993 to 2002 generation rates and 2000 to 2002 shipment reports data.
[c] Estimate based on 4,666 metric tons (FY2001) and an average 9 to 13 metric tons per truck.

The Central Stores, Building 411, is located in the southeast quadrant of the Livermore Site. This 69,505-gross-square-foot building is managed by the Procurement and Material Department and handles all onsite receiving and temporary storage and offsite shipment of materials to Site 300. Material deliveries (nonhazardous, hazardous, and radioactive) are received here and sorted and are forwarded to the requesting program. Only standard (nonhazardous) supply items are placed in the storage area in Building 411, and program representatives can obtain needed material from Central Stores.

For Site 300, no central storage facility is currently in operation. Materials are shipped from the Livermore Site directly to the user facility at Site 300.

B.4.14.2 *Hazardous Waste Shipments*

In Calendar Year (CY) 2002, a total of 119 hazardous waste shipments were made. Table B.4.14.2–1 breaks down the CY2002 shipments by treatment and disposal facilities. The shipment sizes vary with the urgency and required treatment/disposal options for a particular shipment. Most offsite shipments of hazardous waste are loaded at Area 612 and the DWTF complex. For Site 300, offsite waste shipments originate from Building 883.

TABLE B.4.14.2–1.—*Combined Livermore Site and Site 300 Hazardous Waste Shipments[a] in CY2002*

Treatment/Disposal Site	State	Number of shipments	Waste Types
Safety-Kleen Inc.	CA	34	RCRA hazardous, state-regulated, and nonregulated waste
Altamont Landfill	CA	14	Asbestos and nonregulated waste
Lawrence Livermore National Laboratory[b]	CA	9	RCRA hazardous, state-regulated, and nonregulated waste
Envirosafe Services of Idaho, Inc.	ID	8	Hazardous and TSCA (PCB-related) wastes
Heritage Environmental Services, LLC	AZ	7	RCRA hazardous and nonregulated waste
Twenty First Century EMI	NV	6	RCRA hazardous and nonregulated waste
ENSCO West Inc.	CA	5	RCRA hazardous and nonregulated
Sub Total		83	waste
Other sites[c] (including Site 300[d])	Various	36	Various, including explosive wastes
Total		**119**	

Source: LLNL 2003ax.

[a] Hazardous waste shipments include RCRA hazardous waste, state-regulated, TSCA waste, wastes shipped for recycle, and nonregulated wastes (wastes not specifically regulated by RCRA; TSCA or the State of California that may contain materials of concern and are treated and disposed as if the wastes were regulated. [e.g., wastes containing PCBs less than 50 parts per million]).

[b] Site 300 routinely ships wastes to the Livermore Site.

[c] LLNL uses nearly 50 commercial treatment, storage, and disposal facilities (TSDFs). Due to the wide-range of wastes, including recyclable materials, a large number of TSDFs is needed. These TSDFs include incinerators, liquid treatment facilities, landfills, and recyclers. Capabilities at these TSDFs include fuel blending, solvent recovery, mercury processing, asbestos disposal, battery reclamation, and other special waste handlers including radioactive waste TSDFs.

[d] The Livermore Site ships explosive-related waste to Site 300 for treatment.

Note: Site 300 ships hazardous, radioactive, and mixed wastes to Livermore Site for storage, treatment, and preparation for final offsite disposal, as appropriate.

B.4.14.3 *All Other Waste Shipments*

A summary of all other waste shipments is presented in Table B.4.14.2–1.

B.4.15 Materials and Waste Management

B.4.15.1 *Materials*

LLNL maintains an inventory of radioactive, chemical, and explosive materials used in laboratory R&D in a wide variety of scientific, engineering, and weapon-related fields.

To safely control these materials, LLNL employs an integrated safety management system (ISMS) to manage the use of hazardous materials. The ISMS process includes project planning, hazard assessment, identification, and implementation of measures to perform work in a safe manner.

LLNL tracks and manages hazardous materials from receipt through transfer, storage, use, and final disposition (this may include disposal; however, for example, empty gas cylinders are returned to the vendor for reuse). Different inventory systems are used for radioactive, chemical, and explosive materials, which track materials for inventory and waste control.

Radioactive Material

Radioactive material has the property of spontaneously emitting alpha, beta, or gamma rays during the disintegration of an atom's nucleus. Radioactive material is found in nature or can be man-made. All radioactive material, used in activities at LLNL and present in quantities sufficient to be deemed hazardous, is controlled to protect LLNL workers, the public, and the environment. LLNL manages special nuclear material, source material, other nuclear material, and miscellaneous radioactive material.

Special nuclear material includes plutonium or highly enriched uranium (HEU). The majority of the plutonium and HEU is in the form of metal sealed in containers. The inventory consists mostly of heat sources, components (a part or piece of a larger system), targets, and calibration sources. LLNL does not produce plutonium.

Source material includes uranium and thorium. LLNL's inventory of natural, low enriched, or depleted uranium is either stored in specially designed containers or in large, sealed assemblies to minimize the probability of a release. The majority of the source material inventory at LLNL is in the form of metal sealed in containers. The inventory consists mostly of targets, shielding, components, and calibration sources. LLNL does not produce these materials.

Other nuclear material includes americium, californium, tritium, and lithium. These materials are used at LLNL for national defense research purposes. LLNL does not produce these materials.

Miscellaneous radioactive materials include strontium, cobalt, and cesium. These materials are used at LLNL for both nondefense and defense research purposes. LLNL does not produce or process these materials.

Table B.4.15.1–1 is a listing of facility inventories (or administrative limits) for radioactive materials at LLNL. The table shows typical quantities rather than maximum limits.

TABLE B.4.15.1–1.— *Facilities Managing Radionuclides[a] at LLNL*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
Building 131 High Bay	Natural thorium Depleted uranium Inventory maintained below Category 3 thresholds	0.5 kg 7,700 kg	Radiological facility
Building 132N	Natural uranium Depleted uranium Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 132S	Natural uranium Depleted uranium Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 151	15 radionuclides	Inventory maintained below Category 3 thresholds. Ratio approximately 0.633[b]	Radiological facility
Building 152	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 154	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 190	Tritium Cobalt-60 Americium-241 Plutonium-238 Plutonium-239	20.0 Ci 1.43×10^{-4} Ci 1.11×10^{-5} Ci 0.027 Ci 1.50 Ci	Radiological facility
Building 191	Depleted uranium	0.008 Ci	Radiological facility
Building 194	Uranium-235 Plutonium-239 Sealed sources	0.192 kg 0.003 kg Inventory maintained below Category 3 thresholds	Radiological facility
Building 231	Natural thorium Natural uranium Depleted uranium Rhenium	0.5 kg 9.5 kg 3,000 kg 60 kg	Radiological facility
Building 231 vault	Natural thorium Uranium-235 Uranium-238	11 kg 3.4 kg 1,700 kg	Radiological facility
Building 232 Fenced Area and 233 Vault	Thorium Low enriched uranium Natural or depleted uranium	150 kg 0.3 kg 4,000 kg	Radiological facility
Building 239	Plutonium, fuel grade equivalent[e] Highly enriched uranium[e] Depleted uranium Tritium	6 kg 25kg/50 kg[f] 500 kg 0.02 kg	Varies; resident inventory maintained below Category 3 thresholds

TABLE B.4.15.1–1.— *Facilities Managing Radionuclides[a] at LLNL (continued)*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
Building 241	Depleted uranium	2,650 kg	Radiological facility
	5 radionuclides	Inventory maintained below Category 3 thresholds	
Building 251	42-Category 2 radionuclides	Inventory maintained below Category 2 thresholds	Category 2 facility
Building 255E	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 261/262	16 Radionuclides	Inventory maintained below Category 3 thresholds	Radiological facility
	Thorium	100 lbs (Metal)	
	Natural uranium	100 lb	
	Depleted uranium	300 lb	
Building 322	Depleted uranium	30 kg	Radiological facility
Building 327	Depleted uranium	95 kg	Radiological facility
Building 331[g]	Tritium[e]	0.030kg/0.035 kg[f]	Inventory is distributed between two segments; small quantities of other radionuclides may be present but the facility will remain a Category 3 facility
	Plutonium-239	900 g	
	Plutonium, fuel-grade equivalent	260 g	
	Uranium-235	700 g	
	HEU	5 kg	
Building 332	Plutonium[e]	700kg/1,400 kg[f]	Category 2 facility
	Enriched uranium[e]	500 kg	
	Depleted or natural - uranium[e]	3,000 kg	
Building 334[g]	Plutonium, fuel grade equivalent[e]	18 kg	Category 3 facility
	Enriched uranium	100 kg	
	Depleted uranium	500 kg	
	Tritium	0.0001 kg	
Building 361	Phosphorus-32	0.027 Ci	Radiological facility
	Sulphur-35	0.008 Ci	
	Carbon-14	0.131 Ci	
	Tritium	0.29 Ci	
Building 362	Carbon-14	0.036 Ci	Radiological facility
	Tritium	0.006 Ci	
Building 363	Carbon-14	0.002Ci	Radiological facility
	Tritium	0.001 Ci	
Building 364	Cesium-137 (sealed source)	3.5×10^3 Ci	Radiological facility
Building 366	Phosphorus-32	0.007 Ci	Radiological facility
Building 378	20 radionuclides (Sealed sources)	Inventory maintained below Category 3 thresholds	Radiological facility
Building 379	20 radionuclides (Sealed sources)	Inventory maintained below Category 3 thresholds	Radiological facility
Building 381	Tritium	8.5 Ci (storage limit – 20 Ci)	Radiological facility
	Sealed sources	Inventory maintained below Category 3 thresholds	

TABLE B.4.15.1–1.— *Facilities Managing Radionuclides[a] at LLNL (continued)*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
RHWM Facilities (Area 514)	Miscellaneous radionuclides	Inventory maintained below Cat 3 thresholds	Radiological facility
RHWM Facilities (Area 612)	Cat 2 radionuclides	See Appendix B for inventory limits	Category 2 facility
DWTF Buildings 695/696S	Cat 3 radionuclides	See Appendix B for inventory limits	Category 3 facility
DWTF Building 693/ 696RWSA	Cat 2 radionuclides	See Appendix B for inventory limits	Category 2 facility
Cargo Container Testing facility (planned)	Depleted or natural uranium Uranium-235 Plutonium-239 Sealed sources	50 kg 1.0 kg (metal), 0.2 kg (oxide) 0.40 kg Inventory maintained below Category 3 thresholds	Radiological facility

Source: LLNL 1999b, g; LLNL 2000d, k, l, o, p; LLNL 2001b,e, f, aw; LLNL 2002ar, cq, co.
[a]Summary information, additional radionuclides may be present in these facilities
[b]Ratio of activity to Category 3 threshold must be below 0.8 in order for a radiological accident analysis to not be required in a hazard analysis report.
[c]Inventories are snapshots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
[d]Category 2 – Hazard analysis shows the potential for significant onsite consequences. Category 3 – Hazard analysis shows the potential for only significant localized consequences. Radiological–Facilities that do not meet or exceed Category 3 threshold criteria but still possess some amount of radioactive material. Category 2 and Category 3 thresholds are defined in DOE Standard DOE-STD-1027-92 (DOE 1997d).
[e]Administrative limit.
[f] Values are included for No Action Alternative and the Proposed Action, respectively.
[g]Materials in Buildings 331 and 334 are within the Superblock Administrative Limits for plutonium and uranium.
Ci = curies; DWTF = Decontamination and Waste Treatment Facility; kg = kilograms; RHWM = radioactive and hazardous waste management; RWSA = radioactive waste storage area.

Chemicals

Because of the wide variety of research activities performed at LLNL, the amounts and concentrations of chemicals maintained at LLNL vary at any given time and from facility to facility. Most research operations use small quantities of a wide variety of chemicals; however, in some operations, chemicals are used in large quantities. In general, the following chemical types are used and stored at LLNL: corrosives (acids and bases); toxics (poisonous chemicals); flammables and combustibles (solids, liquids, and gases); reactives (materials that are inherently readily capable of detonation or becoming flammable at normal temperatures and pressures); asphyxiates (physical asphyxiates are materials capable of physically displacing the volume of air in a given space; chemical asphyxiates are materials that are poisonous when breathed); and carcinogens (materials capable of inducing cancer).

In 2001, more than 166,000 chemical containers, ranging from 55-gallon drums to gram-quantity vials, were in use or stored at LLNL (LLNL 2002cc). Table B.4.15.1–2 presents a list for FY2001 – FY2002 of hazardous chemicals at the Livermore Site. The values are estimated maximum values for a single facility or average values over several facilities. Table B.4.15.1–3 presents a list of FY2001 – FY2002 of hazardous chemicals at Site 300. Table B.4.15.1–4 presents a list of hazardous chemicals at waste management facilities.

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002*

Material	Maximum/ Average Quantity[a]	Location[b]
1,1,1,2-Tetrafluoroethane (Refrigerant 134A)	1,600/500 lb	132N, 132S, 404, 511, 5207
1,1,1-Trichloroethane	220/70 gal	131, 132N, 151, 153, 165, 191, 243, 253, 281, 292, 298, 335, 391, 697
Acetic acid	500/100 gal	Located in more than 30 buildings.
Acetone	1,200/740 gal	Located in more than 70 buildings.
Acetonitrile	200/55 gal	132N, 132S, 151, 153, 154, 191, 197, 241, 253, 281, 298, 361, 363, 364, 432, 435, 691
Acetylene	83,000/60,000 ft^3	Located in more than 50 buildings.
Acoustical Tile Adhesive	200/55 gal	261, 418, 433, 511, 512, 523, 525, 531
Actrel 4493L Cleaner	170/165 gal	697
Aero Melamine	3,500/1,100 lb	132N, 191, 231, 281, 363
Air, Compressed	85,000/68,000 ft^3	131,132N, 151, 241, 281, 324, 391, 432, 435, 518, 5475, 5477
Aluminum hydroxide	1,600/530 lb	
Aluminum oxide (Alumina)	2,500/840 lb	Located in more than 30 buildings.
Ammonia, anhydrous	Combined with Ammonium hydroxide	132N, 132S, 151, 153, 191, 197, 292, 362, 391, 5207
Ammonium hydroxide	3,600/200 gal	Located in more than 30 buildings.
Ammonium nitrate	2,000/500 lb	132N, 151, 191, 197, 231, 241, 243, 281, 298, 322, 361, 377, 378, 446
Antifreeze, coolant	260/80 gal	131, 132N, 132S, 141, 176, 191, 197, 198, 231, 241, 253, 298, 321C, 322, 323, 332, 361, 366, 377, 391, 418, 490, 511, 519, 697
AQUA POWER, Cleaner/Degreaser	150/55 gal	291, 418, 511, 519, 6203
Argon, compressed	25,000,000/ 160,000 ft^3	Located in more than 60 buildings.
Asbestos-Free Roof Cement	165/55 gal	515
Asphalt Emulsion-seasonal product do not delete	1,100/55 gal	515
Barrett SN	300/230 gal	292, 321A, 322
Belsperse 161, Dispersant	6,500/3,000 lb	438
Beryllium	1,600/1,000 lb	131, 194
Beryllium oxide	500/350 lb	131, 321
Boron	2,600/500 lb	121, 132N, 132S, 151, 162, 182, 191, 231, 235, 697
Bright Plating solution	1,30/55 gal	322
Brulin MP 1793	200/100 gal	231, 321, 321C, 391
BSP Captor Solution	170/55 gal	291

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Bulls Eye 1-2-3 Primer/Sealer	750/55 gal	131, 335, 418, 6297
Butyl alcohol (n-Butanol)	510/55 gal	121, 132N, 151, 153, 154, 191, 231, 235, 241, 253, 281, 292, 298, 324, 328, 361, 362, 363, 364, 366, 391, 446, 697
Calcium chloride	3,200/500 lb	132N, 132S, 151, 154, 162, 191, 231, 235, 241, 243, 281, 292, 298, 322, 332, 361, 362, 363, 364, 366, 377, 378, 435, 436, 446, 612, 697
Calcium sulfate	1,300/500 lb	Located in more than 40 buildings.
Carbon, activated	800/500 lb	132N, 141, 151, 153, 154, 162, 190, 191, 235, 241, 261, 281, 292, 2925, 294, 298, 3203, 322, 361, 363, 381, 391, 478, 446, 597, 697
Carbon dioxide	176,000/124,000 ft^3	Located in more than 30 buildings.
Carbon monoxide	4,000/1,300 ft^3	132N, 132S, 141, 151, 162, 231, 235, 241, 243, 253, 281, 362, 363, 391, 435
Celite 535	2,000/950 lb	514
Cement, Kast-o-lite	1,300/500 lb	511
ChemTreat BL-1253	1,200 gal	291, 511
ChemTreat BL-1302	600 gal	291
ChemTreat BL-1543	110/55 gal	291
ChemTreat BL-1776	1,000/140 gal	291, 511
ChemTreat BL-1821	700/55 gal	291
ChemTreat CL-1467	700/55 gal	291
ChemTreat CL-2111	800/300 gal	291, 684
ChemTreat CT9001-Antifoulant	55/55 gal	291
Chlorine	750/500 ft^3	151, 153, 166, 197, 298, 332, 391
Chloroform	110/55 gal	131, 132N, 151, 153, 154, 162, 191, 197, 241, 243, 253, 281, 292, 294, 298, 322, 332, 361, 362, 363, 365, 366, 391, 435, 446, 612
Chrome or Chromium	4,700/1,500 lb	121, 151, 152, 154, 176, 212, 231, 235, 241, 281, 332, 378, 391, 697
Chromium(III) chloride	12/1 lb	132N, 151, 162, 241, 281, 298, 3203
Citric acid, anhydrous	1,600/400 lb	132N, 151, 153, 191, 231, 235, 241, 255, 281, 292, 294, 298, 322, 361, 362, 363, 364, 366, 377, 378, 391, 392, 446, 697
Cobalt	16,500/14,000 lb	121, 132N, 151, 152, 162, 212, 231, 235, 241, 292, 361, 391, 697
Concresive Adhesive, Part A/B	330/55 gal	166, 332, 335, 418, 509, 511, 6203
Copper sulfate, crystals & solution	1,100/500 lb	132N, 191, 281, 322, 697
Cutting fluid, Aluminum A-9	100/90 gal	121, 191, 194, 212, 281, 321, 391, 423, 432, 511, 525
Cutting fluid, Cool Tool (I & II)	390/55 gal	131, 132N, 132S, 141, 153, 166, 173, 194, 231, 241, 243, 292, 298, 321, 331, 383, 391, 423, 443, 511

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Cyanuric acid	2,500/500 lb	132N, 151, 191, 231, 281, 291, 318
Dascool 2227	500/55 gal	321
DDO-19, Lubricating oil	500/55 gal	292, 321, 332, 512
Delvac Motor oil	300/55 gal	321, 519
DESMODUR	110/55 gal	191, 231, 5127
Detergent, ND 150	300/55 gal	423, 511, 515, 519, 531, 611
Diesel	30,000/10,000 gal	131, 141, 162, 194, 231, 241, 253, 291, 298, 343, 364, 381, 412, 431, 435, 452, 511, 519, 611, 622
Dimethyl sulfoxide	220/55 gal	132N, 132S, 151, 154, 162, 191, 231, 241, 253, 281, 298, 322, 332, 361, 362, 363, 364, 366, 377, 435, 446, 697
4,4'-Diphenylmethane diisocyanate	1,000/500 lb	231
DowTherm SR-1 30 Heat Transfer Fluid	110/55 gal	432
ELNIC 100 C-5	250/55 gal	322
ELNIC 100 RP-1	60/60 gal	322
ELNIC 100 RP-2	150/110 gal	322
Epolene Wax, Polyethylene, oxidized	110/55 gal	191, 231
Ethyl alcohol	2,000/1,500 gal	Located in more than 60 buildings.
Ethylene, compressed	5,700/1,900 ft^3	132N, 134, 154, 241, 298, 394, 435, 446
Ethylene glycol	500/110 gal	Located in more than 30 buildings.
Ethyl silicate	150/55 gal	121, 132N, 1477, 151, 191, 243, 298, 391
Ferric chloride, Iron chloride(III)	1400/500 lb	132N, 132S, 151, 153, 191, 235, 241, 243, 281, 294, 298, 321, 361, 378, 435, 446
Ferric sulfate	3,500/700 lb	132N, 151, 191, 243, 322, 361, 442, 446, 514, 697
Fertilizer, Pro-Turf 25-3-10	11,000/5,500 gal	531
Freon 11 (Trichlorofluoromethane)	10,000/5,000 lb	281, 292, 404, 697
Freon 12 (Dichlorodifluoromethane)	6,300/4,000 lb	132N, 134, 190, 197, 241, 253, 292, 341, 394, 404, 511, 5207, 611
Freon 14 (Tetrafluoromethane)	2,500/500 ft^3	132N, 132S, 134, 141, 153, 166, 190, 197, 298, 391, 394
Freon 22 (Chlorodifluoromethane)	9,000/5,000 lb	197, 253, 261, 361, 404, 511, 5207
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	17,000/5,000 lb	Located in more than 30 buildings.
Gasoline	24,000/24,000 gal	611
Glass Cleaner, variety	2,300/200 gal	Located in more than 110 buildings.
Glycerine	110/55 gal	Located in more than 30 buildings.
Hafnium oxide	4,700/4,500 lb	131, 132N, 151, 162, 174, 231, 241, 281, 697
Halocarbon 23	400/200 ft^3	231

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Halon 1301 (Bromotrifluoromethane)	2,000/1,600 lb	404
Helium	5,000,000/300,000 ft^3	Located in more than 70 buildings.
Herbicide, Ronstar	2,000/700 lb	519, 520, 531
Herbicide, Roundup	220/40 gal	520, 531
Hexane	250/160 gal	131, 132N, 132S, 151, 154, 191, 231, 241, 253, 281, 292, 298, 327, 341, 361, 362, 363, 612, 691, 697
Hydrochloric acid	600/400 gal	Located in more than 40 buildings.
Hydrogen chloride (gas only)		132S, 134, 151, 162, 166,191, 197, 212, 231, 235, 323, 332
Hydrofluoric acid	1,500/850 lb	132N, 132S, 151, 153, 154, 162, 166, 176, 197, 212, 231, 235, 241, 243, 253, 254, 2554, 281, 292, 294, 298, 322, 332, 378, 391
Hydrogen, compressed	1,500,000/50,000 ft^3	Located in more than 30 buildings.
Hydrogen peroxide<52%	350/55 gal	Located in more than 40 buildings.
Insulating Oil, Inhibiting	1,800/1,200 gal	423, 431, 435
Isopropyl alcohol	650/550 gal	Located in more than 80 buildings.
Joint Compound, All purpose	45,000/12,100 lb	Located in 40 buildings.
Kerosene (Naphtha Petroleum)	300/55 gal	132N, 132S, 141, 151, 171, 194A, 197, 231, 235, 342, 251, 292, 321, 331, 332, 341, 376, 418, 432, 436, 612, 697
Kodak Fixer & Replenisher	650/250 gal	141, 151, 174, 191, 261, 327, 361
Krypton, compressed	1,600/1,100 ft^3	121, 131, 132N, 132S, 141, 151, 162, 194, 197, 212, 235, 241, 298, 391
Lead Bricks or ingots	950,000 lb	Multiple
Lithium Grease	110/55 gal	131, 141, 194A, 235, 332, 391, 406, 411, 442, 511, 514, 519, 597, 611, 6203
Lithium Hydride	4,000/4,000 lb	131, 194, 231, 231V, 232FA, 233V, 321, 612, 614, 625, 693
Lubricating Oil	500/300 gal	131, 151, 153, 162, 191, 231, 281, 321, 332, 341, 362, 435, 443, 511, 517, 519, 611, 697
Macro Brite L-7	220/110 gal	322
Magnesium chloride	6,000/500 lb	132N, 151, 162, 166, 212, 241, 243, 255, 281, 292. 298, 3203, 361, 363, 364, 366, 377, 435, 697
Manganese	3,500/3,000 lb	121, 132N, 151, 162, 212, 231, 235, 241, 243, 281, 294, 298
Mastic Patch adhesive, variety	400/55 gal	151, 332, 418, 511, 523, 6203, 6297
Metex L-5B	220/55 gal	322
Methane	100,000/30,000 ft^3	Located in 40 buildings.
Methyl alcohol	1,800/500 gal	Located in more than 60 buildings.
Methylene chloride	2,000/55 gal	121, 132N, 132S, 151, 154, 162, 165, 166, 174, 1879, 191, 231, 235, 241, 253, 255, 281, 292, 298, 321, 331, 361, 362, 363, 377, 381, 3905, 391, 418, 513, 697

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Methyl ethyl ketone	400/55 gal	121, 1277, 132N, 151, 153, 162, 165, 191, 194, 197, 231, 235, 253, 281, 298, 327, 361, 3905, 391, 432, 442, 6297, 697
Mineral dust, Aquaset	10,000/4,500 lb	335, 419, 514
Mineral oil	2,000/55 gal	Located in more than 40 buildings.
Mineral spirits	400/55 gal	121, 154, 191, 235, 281, 332, 418, 523, 6297, 697
Modified Bitumen adhesive	350/200 gal	511, 515, 523
Neodymium oxide	7,000/1,350 lb	121, 132N, 151, 162, 191, 212, 241, 243, 378, 4999, 697
Neon, compressed	750,000/500,000 ft^3	131, 132N, 134, 151, 162, 174, 191, 194, 197, 212, 231, 235, 298, 341, 381, 391, 394, 4299, 445
Nickel	1,500/500 lb	121, 132N, 132S, 151, 153, 162, 191, 231, 235, 239, 241, 243, 253, 2629, 281, 332, 378, 391, 697
Nickel chloride	80/70 gal	132N, 151, 197, 235, 281, 298, 361, 377, 378, 446, 697
Nickel sulfate	220/110 gal	151, 231, 235, 281, 322, 361, 697
Nitric acid	5,000/1,800 lb	Located in more than 40 buildings.
Nitric oxide	1,000/500 lb	132S, 134, 191, 197
Nitrogen, compressed (Liquified, gaseous)	38,000,000/ 18,000,000 ft^3	Located in more than 80 buildings.
Nitrous oxide	4,000/1,200 ft^3	132S, 141, 153, 166, 197, 253, 281, 292, 435
Oakite (Liqui-det)	80/55 gal	132N, 132S, 141, 151, 194, 196, 231, 235, 243, 251, 298, 321, 322, 329, 331, 332, 341, 361, 362, 363, 383, 423, 445, 511
Oil, Diala AX	2,200/1,050 gal	141, 1481, 191, 194, 2801, 321, 327, 341, 423, 515, 691
Oil, DTE-24	700/440 gal	131, 132N, 321, 341, 519
Oil, DTE-25	450/355 gal	321, 442
Oil DTE-26	2,000/400 gal	131, 190, 231, 321, 511, 518, 519
Oil, DTE, extra heavy	500/165 gal	321, 519, 697
Oil, DTE heavy	850/55 gal	321, 519
Oil, DTE Medium	220/55 gal	321, 445, 519
Oil, Spindle	700/355 gal	321, 423, 697
Oil, Tellus, variety	275/55 gal	132N, 261, 697
Oil, Vactra, variety	500/400 gal	131, 191, 298, 321, 321C
Oil, Vacuum Pump fluid, variety	1,500/55 gal	121, 132N, 151, 153, 176, 194, 235, 241, 253, 292, 298, 321, 362, 376, 377, 391, 438, 697
Oil, Waste	2,500/1,000 gal	611
Oxalic acid	700/500 lb	132N, 132S, 151, 231, 235, 254, 255, 281, 294, 322, 329, 332, 361, 378, 446, 697
Oxygen, compressed	870,000/75,000 ft^3	Located in more than 60 buildings.
OzzyJuice SW3, Cleaner/Degreaser	300/55 gal	131, 132S, 241, 383, 511, 611
Paint (variety)	700,000/320,296 lb	Located in more than 80 buildings.
Perchloroethylene (Tetrachloroethylene)	250/55 gal	132N, 243, 281, 298, 322, 329, 341, 446, 697

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Phosphoric acid	3,600/1,000 lb	Located in more than 30 buildings.
Potassium chloride	3,500/1,200 lb	Located in more than 30 buildings.
Potassium hydroxide	15,000/400 lb	Located in more than 30 buildings.
Potassium Phosphate, Monobasic	10,000/2,000 lb	132N, 151, 162, 165, 166, 1678, 191, 253, 281, 292, 361, 363, 366, 435
Potassium silicate	1,100/500 lb	132N, 281, 298
Power Plus, Cleaner/Degreaser	110/55 gal	611
Printing Ink, variety	1,000/850 lb	261, 551W
Propane	45,000/1,000 gal	Located in more than 70 buildings.
Refrigerant, 123 Suva, (2,2-Dichloro-1,1,1-Trifluoroethane)	35,000/1,500 lb	404
Refrigerant 406A	720/500 lb	404, 511, 5207
Rough Rider Emulsion Degreaser	110/55 gal	364, 531
Rubinate fluid	110/55 gal	231
Sanding Sealer	200/90 gal	418, 511, 6297
sec-Butanol	130/122 gal	132N, 191, 253, 298, 361, 364, 377, 391, 3981, 432
Shur-Stik Wall Covering Adhesive	110/55 gal	418, 511, 6297
Silane, compressed	2,100/200 ft^3	153, 166, 197, 391
Silicon carbide	3,200/500 lb	121, 131, 132N, 132S, 151, 194, 231, 235, 243, 298, 391
Silicone Transformer Fluid/Dow	700/165 gal	235, 253, 515, 697
Simple Green Degreaser	140/55 gal	131, 191, 243, 321A, 322, 324, 418, 442, 511, 519
Sodium bicarbonate	3,600/500 lb	Located in more than 30 buildings.
Sodium chloride	3,200/800 lb	Located in more than 40 buildings.
Sodium cyanide	250/100 lb	132N, 151, 191, 231, 3203, 322, 361, 363, 378, 697
Sodium hydroxide	25,500/14,000 lb	Located in more than 50 buildings.
Sodium hypochlorite (Bleach)	12,000/1,000 gal	Located in more than 40 buildings.
Sodium nitrate	1,500/350 lb	132N, 151, 162, 191, 231, 241, 243, 253, 281, 294, 322, 361, 377, 378, 435, 436, 446, 597, 612, 697
Solvent AZ-EBR	165/55 gal	298
Spill clean-up kit, Acids	1,600/500 lb	Located in more than 30 buildings.
Spill clean-up kit, Caustic	1,000/500 lb	132N, 132S, 151, 153, 154, 166, 1727, 197, 231, 235, 253, 254, 255, 261, 281, 292, 294, 298, 3203, 327, 331, 332, 341, 378, 514, 612, 697
Spill clean-up kit, Solvent	710/500 lb	Located in more than 30 buildings.
Strontium phosphate	1,400/350 lb	162

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Sulfur hexafluoride, compressed	25,000/10,000 ft^3	134, 141, 151, 153, 190, 191, 194, 197, 212, 231, 235, 253, 281, 381, 391, 424, 431, 515, 518, 6126
Sulfuric acid	11,000/4,500 lb	Located in more than 40 buildings.
Super Dropout	1,590/1,590 lb	442, 513
Suva MP39 (R401A)	800/600 lb	141, 404, 5207
Suva MP66 (R401B)	180/180 gal	511, 5207
Tantalum	75,000/20,000 lb	121, 132N, 132S, 151, 191, 212, 231, 241, 243, 281, 697
Tantalum oxide blend	17,000/8,500 lb	132N, 151, 152, 231
Thinner, Lacquer	3,000/500 gal	121, 132S, 141, 176, 231, 332, 365, 391, 418, 438, 511, 512, 5125, 517, 519, 523, 611, 6203, 6297
Toluene	480/300 gal	Located in more than 30 buildings.
TPX	800/800 lb	231
Transmission fluid, Dexron II (ATF)	220/55 gal	321, 519, 523
Trichloroethylene	350/165 gal	131, 132N, 132S, 141, 151, 153, 165, 191, 194, 197, 231, 235, 241, 243, 253, 281, 292, 298, 322, 332, 341, 391, 392, 445, 446, 691, 697
Trim Clear	110/55 gal	321A, 321C
Trim Sol, coolant	660/165 gal	121, 169C, 231, 241, 281, 298, 321, 331, 383, 391, 431, 432, 435, 511, 625, 691
Tungsten	2,500/500 lb	121, 132N, 132S, 151, 231, 235, 243, 281, 341
Ultra NZ, Floor Wax		531
Voranol	110/55 gal	231, 391
Wax, Floor	300/300 gal	512, 531, 6203
Xenon, compressed	2,000/500 ft^3	121, 132N, 132S, 162, 166, 191, 194, 197, 198, 212, 231, 235, 241, 298, 361, 391, 435
ZEP Formula 50	110/55 gal	321

Source: LLNL 2002m.

Note: Some buildings are part of a complex and employ small ancillary storage facilities. The above list does not denote these facilities. Locations vary year to year. The listing of facilities is not intended to limit inventories. Physical space and administrative controls including safety documentation limit inventories. This table is provided to give the reader an understanding of the types of chemicals, general quantities and variety of locations.

[a] Maximum/Average Quantity: Maximum is defined as a maximum at one of the facilities in a given year. Average is defined as the average quantity found at multiple facilities.

[b] For chemicals located in 30 or more buildings, no location list is provided.

ft^3 = cubic feet; gal = gallons; lb = pounds.

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002*

Material	Maximum/ Average Quantity[a]	Location
Acetone	400/30 gal	827, 801, 812, 826, 836, 850, 851, 874, T8010, 875, 899
Acetylene	10,000/7,500 ft^3	801, 876, 873, 874, 875, 879, T8340, 811, 843
Activated Carbon	20,000/15,000 lb	827, 843, 834
Air	28,000/15,000 ft^3	801, 802, 812, 850, 851, 843, 875, 834, T8340
Alcoa Atomized Powder	3,000/2,000 lb	827, 805, 827, 872
Ammonium Perchlorate	760/760 lb	827
Argon	30,000/30,000 ft^3	801, 850, 851, 873, 874, 875, 876, 827
Asphalt Emulsion	300/200 gal	819, 843, 873
Auto Transmission Fluid (including Dextron)	400/300 gal	875, 876, 879
Bacticide Solution	220/110 gal	875
n-Butyl Acetate	55/55 gal	827, 810
Calla Soap	165/55 gal	875
Carbon Dioxide	44,000/5,000 ft^3	834, 843, 874, 875, 879
Cast Iron, Shot (Chips)	6,000/6,000 lb	843
Chlorine	2,250/1,500 lb	812, 844, 847, 853, 886, 888, Well Nos. 18 & 20, Tank boosters
Cleaner, Degreaser, Big Orange	110/55 gal	873, 874, 875, 880, 851
Cleaner, Butcher's Hot Springs	55/55 gal	875
Cleaner, Degreaser, Clean-Way II	110/55 gal	879
Cleaner, Degreaser, Ozzy Juice SW-3	330/110 gal	875, 879
Coating, Acrylic Terpolymer	244/90 gal	843
Coating, Polytherm, FP-576	220/110 gal	873
Coating, Polyurethane, Vulkem 350, Gray	60/60 gal	872
Coating, Polyurethane, Vulkem 351, Gray	110/55 gal	843, 872
Coating, Roof, Acrylic	2,500/500 gal	872, 819, 843, 873
Condensate wastewater	4,500/3,600 gal	875
Cyanuric Acid	500/50 lb	827D Yard
Diesel	12,000/10,000 gal	871, 875, 879, and 882 underground tanks; 805, 810, 827, 834, 836, and 870 aboveground tanks.
Dimethyl Sulfoxide	400/55 gal	827D Yard, 821
2,2-Dinitropropanol in EDC	275/275 gal	821
Ethyl Acetate	100/30 gal	827, 810, 873
Ethyl Alcohol	56/56 gal	801, 802, 806, 810, 812, 817, 823, 825, 827, 850, 851, 872, 874
Ethylene Glycol	200/100 gal	801, 802, 805, 809, 823, 827, 836, 843, 875, 879, 896

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location
FEFO SOL (in methylene chloride)	1,100/10 gal	821
Floor wax	165/110 gal	873
Freon 12	660/220 lb	875, 801, 879
Freon 13	478/478 ft^3	834
Freon 22	1,400/870 lb	851, 875
Freon 113 (Freon, TF)	150/110 gal	875, 801, 806, 817, 823, 836, 850
Gasoline	15,000/15,000 gal	879
Glycerine	165/165 gal	817, 810, 875
Helium	25,000/25,000 ft^3	801, 802, 812, 848, 851, 873, 874, 882, 834, 850, 843, 865, 875
n-Hexane	220/220 gal	827D
High Explosives	100,000/10,000 lb	locations site-wide
Hydrogen	700/700 ft^3	843, 875
Isoamyl alcohol	55/55 gal	827D
Isopropyl Alcohol	300/100 gal	801, 806, 810, 817, 834, 836, 850, 858, 873, 874, 827E, 805, 827D
Kerosene	160/5 gal	875
Krovar I DF Herbicide	2,000/500 lb	819
Lacquer Thinner	110/35 gal	T8010, 843, 872, 873
Lead (bricks, ingots)	25,000/5,000 lb	801, 802, 803, 812, 825, 826, 827, 845, 850, 851, 879, 869
Lubricant, Synthetic Summit/Vactra, etc.	330/165 gal	836, 805, 875
Methane	3,000/1,500 ft^3	801, 851, 843, 833
Methyl alcohol	90/5 gal	801, 805, 827, 850, 851, 812
Methyl Ethyl Ketone	100/5 gal	827, 843
Mixed Gas, Freon 502	500/200 ft^3	834
Mixed Gas, Freon 503	500/200 ft^3	869
Mixed Gas, Compressed, Not Otherwise Specified (non-hazardous)	1,000/1,000 ft^3	834
Mixed gas, TCE/Nitrogen	7,400/50 ft^3	843
Nalco-71-D5	165/55 gal	875
Nalco-2508	110/55 gal	875
Nalco-2536	55/55 gal	875
Nalco-2593	55/55 gal	869
Nalco-2802	110/55 gal	875
Nalco-2833	55/55 gal	875
Nalco-2858	200/55 gal	827, 875

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location
Nalco-2896	450/250 gal	875
Nitrogen	312,000/280,000 ft^3	801, 819, 836, 850, 851, 854, and misc. site locations
Nitroplasticizer	175/110 gal	821, 827
N-Octane	55/55 gal	827
Oil, Crankcase, 76 Guardol QLT 30	220/55 gal	875
Oil, Hydraulic (DTE, Unocal, CITGO, 76 UNAX AW32)	1,400/700 gal	801, 810, 873, 805, 836, 875
Oil, Inhibited Insulating	25,000/5,000 gal	801, 802
Oil, Mineral	220/55 gal	805, 817, 827
Oil, Motor (all weights)	650/400 gal	875, 879, and misc. site locations
Oil, Shell Oil Tellus 23	110/55 gal	834
Oil, Transformer, Shell Diala-AX/Equivalent	15,000/15,000 gal	801, 846, 865, 874, 836, 851
Oil, Turbine (Extra Heavy, HD 92)	110/55 gal	875
Oil, Vacuum Pump	330/55 gal	875, 827, 851, 806
Oil, Vitrea 100	55/55 gal	875
Oil, Waste	1,000/110 gal	879, 875, 851, 805
Oxygen	16,000/5,000 ft^3	801, 843, 873, 874, 875, 876, 879, 811, T8340
Paint, acrylic (e.g., semi-gloss)	600/100 gal	872, 843, 873, and misc. locations site-wide
Paint, Street Markings	300/55 gal	805, 843, 872, 873, 875, and site-wide
Paint Spray Wastewater	1,200/600 gal	883
Petroleum ether	220/55 gal	801, 827
Photo wastes	400/110 gal	851
Polyol	120/55 gal	827
Propane	20,000/8,000 ft^3	845, 801, and 879 aboveground tanks; also at 841, 851, 873, 874, 875
Roundup herbicide	100/90 gal	819
Sodium bicarbonate	550/40 lb	812, 827, 873, 858
Sodium chloride	7,400/100 lb	805, 817, 827
Sodium hypochlorite/Purechlor Sanitizer/bleach	500/55 gal	875
Sodium nitrate	1,000/16 lb	827
Steam Cleaning Solution/Split Equipment Cleaner	3,000/400 gal	879; Equipment cleaner

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location
STIK-IT Asphalt Base Seal	560/5 gal	843 and misc. locations site-wide
Stoddard solvent/paint thinner	200/60 gal	827, 843, 872, 873, 876, and misc. site locations
Sulfur hexafluoride	19,500/7,700 ft^3	801, 801, 812, 850, 851
Sulfuric Acid	845/60 lb	875

Source: LLNL 2002m.
Note: Some buildings are part of a complex and employ small ancillary storage facilities. The above list does not denote these facilities. Locations vary year to year. The listing of facilities is not intended to limit inventories. Physical space and administrative controls including safety documentation limit inventories. This table is provided to give the reader an understanding of the types of chemicals, general quantities, and variety of locations.
[a] Maximum/Average Quantity: Maximum is defined as a maximum quantity at one of the facilities in a given year. Average is defined as the average quantity found at multiple facilities.
ft^3 = cubic feet; gal = gallons; lb = pounds.

Table B.4.15.1–4.—*Hazardous Chemicals at Selected Waste Management Facilities*

Facility	Materials[a]	Chemical Hazard Classification
DWTF	Sulfuric acid – 2,786 kg Sodium hydroxide (50% solution) – 1,737 kg Hydrogen peroxide (50% solution) – 1,665 kg Ferric sulfate (50% solution) – 1,709 kg Granulated activated carbon – unlimited Chloroform – 67.7 lb Hydrogen peroxide – 39.3 lb Perchloric acid – 35 lb Carbon disulfide – 34.9 lb Other chemical reagents – minor quantities	Low hazard
RHWM (Rollup)	Acetone – 30,400 lb Styrene – 23,000 lb Petroleum oils – 19,270 lb Methanol – 3,383 lb Other chemical reagents – minor to large quantities	Low hazard

Source: LLNL 1999j, LLNL 2000t, LLNL 2003s.
Note: This table is provided to give the reader an understanding of the types of chemicals and general quantities.
[a] All wastes have been removed prior to the expected closure.
kg = kilograms; lb = pounds.

B.4.15.2 *Waste Management*

This section describes the waste generation at LLNL. For a discussion of the regulatory setting, waste management practices, and treatment/storage facilities at LLNL, see Section B.1. The waste generation rates (CY1993–FY2002) presented in this section represent actual data based upon DOE records.

The waste categories routinely generated onsite under normal operations include radioactive waste (including LLW, MLLW, TRU and mixed TRU); hazardous waste, which includes RCRA hazardous (chemical and explosives) waste, California toxic waste, TSCA waste (primarily asbestos and PCBs), and biohazardous (medical) waste; and nonhazardous solid waste and process wastewater. Additionally, LLNL generates nonroutine wastes and expects to generate

wastes from new operations. Each of these categories is discussed separately below. Figure B.4.15.2–1 shows locations of the DWTF and other RHWM facilities.

Normal (Routine) Operations

The affected environment considered under this analysis is limited to those facilities that generate waste under normal (routine) operations at LLNL. Normal operations encompass all current operations that are required to maintain R&D at LLNL facilities.

New Operations

Several new operations are currently under construction or in the operational planning stages at LLNL. However, they are considered outside the scope of the current affected environment description for this analysis because they have not yet reached operational status. New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future. Two facilities, the NIF and the BSL-3 Laboratory, are examples of these new operations.

Special (Nonroutine) Operations

Special (nonroutine) operations generate nonroutine wastes and are limited-duration projects, such as construction, that are considered separately from facility operations. These efforts can make a large contribution to the overall waste generation activities at LLNL. Three areas are considered special operations: construction, D&D, and environmental restoration. Typically, the projects are well-defined so as to allow waste management activities to directly support the project.

Facility maintenance and infrastructure support operations will continue with refurbishment, renovation, and removal of outdated facilities. The LLNL *FY2004 Ten Year Comprehensive Site Plan* and the *LLNL EIS Facilities and Initiatives Report* identify the specific structures under consideration over the next 10 years (LLNL 2003cj). These programs will potentially generate large volumes of TSCA waste, primarily asbestos and building debris that will increase LLNL's disposal needs.

For several years, excess facility management activities have been underway to remove legacy facilities, material, and equipment from the Livermore Site. This effort has removed over 260,000 square feet (LLNL 2002dm). One hundred sixty-one buildings, accounting for 700,000 gross square feet (an estimated 46,000 tons of construction debris), are potentially scheduled for removal. Future space reduction at LLNL will focus on buildings that are beyond their useful lives. These buildings will become vacant after new buildings are built. Twenty-three buildings, accounting for 53,500 gross square feet, are in poor condition and are categorized as beyond their useful life (LLNL 2002dm).

Building debris estimates associated with D&D projects are included in the assessments of the waste generated from special operations (potentially 40,000 tons of debris). However, separate NEPA review may be required in the future depending on the scale and extent of the work involved.

The analysis presented in this document considers environmental restoration activities as nonroutine operations due, in part, to the fluctuation in year-to-year waste quantities. To comply with CERCLA groundwater remedial actions at the Livermore Site, the Environmental Restoration Division (ERD) has designed, constructed, and operated 5 fixed groundwater treatment facilities and associated pipeline networks and wells, 20 portable groundwater treatment units, 2 catalytic dehalogenation units, and 3 soil vapor extraction facilities. In 2001, the ERD operated 4 fixed, 19 portable, 2 catalytic reductive dehalogenation, and 2 soil vapor treatment units. The ERD also installed an electro-osmosis system to improve its ability to remove contaminants from fine-grained sediments.

At Site 300, the ERD has designed, constructed, and operated 3 soil vapor extraction facilities and 11 groundwater extraction and treatment facilities. In addition, the ERD has capped and closed four landfills and the high explosives rinse water lagoons and burn pits, excavated and closed numerous wastewater disposal sumps, and removed contaminated waste and soil to prevent further impacts to groundwater at Site 300.

Radioactive Waste

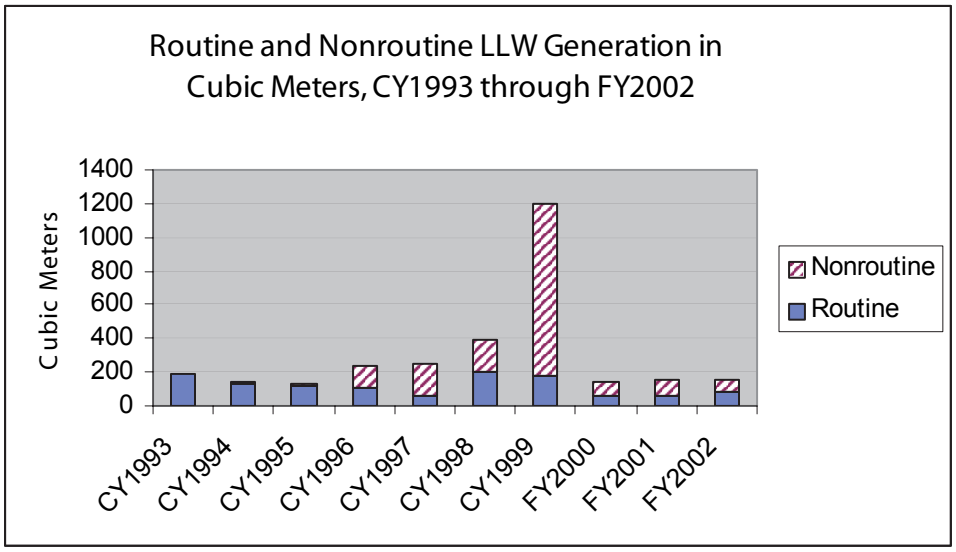
Radioactive waste generated at LLNL includes LLW, MLLW, TRU waste, and TRU-mixed waste. LLNL does not manage or generate high-level waste (a highly radioactive material that results from reprocessing of spent fuel). LLW, MLLW, and TRU wastes are produced primarily in laboratory experiments. Mixed wastes are discussed separately below.

DOE O 435.1 permits onsite storage of LLW and TRU wastes until appropriate disposal becomes available. Currently, there are no regulatory restrictions on the length of time this waste may be stored onsite, provided that disposal or offsite storage options are being pursued and the waste is stored in accordance with all applicable regulations. LLNL maintains the capability to treat solid radioactive wastes onsite. LLNL has treated liquid radioactive wastes at the Treatment Area 514 Tank Farm (LLNL 2002ca). The DWTF is replacing Area 514. LLNL disposes of solid LLW offsite at the Nevada Test Site. Available storage space for LLW and TRU waste is limited by exposure considerations (i.e., radiation exposure to personnel) at a given storage location. However, radioactive wastes, unlike RCRA-regulated wastes, can be stored at various locations onsite provided that the waste is properly packaged, labeled, and monitored. Waste management facilities handling radioactive wastes are listed in Table B.1.1–2.

As part of the effort to minimize the total quantity of radioactive waste that is generated at LLNL, facilities that generate this type of waste are designated as Radioactive Materials Management Areas (RMMAs). An RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material or an area that is exposed to sources of radioactive particles (such as neutrons and protons) capable of causing activation. Managers of facilities must document the locations of all RMMAs. Procedures to minimize the generation of radioactive wastes are then developed.

Historic and Current Radioactive Waste Generation

Radioactive waste has historically been generated from R&D activities that used radioactive materials. Figure B.4.15.2–2, summarizes historic routine and nonroutine LLW quantities (cubic meters) generated onsite from CY1993 through FY2002. From CY1993 to FY2000, annual TRU waste generation ranged from 0 to 12 cubic meters.



Source: DOE 2002s.

FIGURE B.4.15.2–2.—*Routine and Nonroutine LLW Generation in Cubic Meters*

In 2000, LLNL's reporting cycle and quantities changed from calendar year to fiscal year and tons to cubic meters. Table B.4.15.2–1 summarizes current radioactive waste quantities generated onsite from FY2001 and FY2002.

TABLE B.4.15.2–1.— *Generated Radioactive Waste Received by RHWM in FY2001 and FY2002 (in cubic meters)*

Radioactive Waste Generated	2001	2002
LLW	74	159
TRU waste	0	1
Total Radioactive	74	160

Source: DOE 2002s.
LLW = low-level waste; TRU = transuranic.

Legacy waste is considered to be waste material in storage pending disposal. LLNL is in the process of disposing of this waste as treatment and disposal capacity becomes available. For the most part, legacy waste is either radioactive or classified. As of mid-2003, total LLW, Mixed LLW, and TRU waste inventory was 2,178 cubic meters. Table B.4.15.2–2 provides specific radioactive waste quantities by type.

TABLE B.4.15.2–2.—*Radioactive Legacy Waste Quantities in Storage by Type at LLNL RHWM Facilities*

Waste Type	Quantity in Cubic Meters
LLW	1,566
Mixed LLW	506
TRU waste	106
Total inventory[a]	2,178

Source: LLNL 2003v.
[a] Radioactive waste inventory from Buildings 514, 612, 693, 233 CSU, and 883.
LLW = low-level waste; TRU = transuranic.

LLNL maintains the capability to treat radioactive wastes onsite. In 2002, Treatment Area 514 treated 220 cubic meters of LLW, including 63 cubic meters sewered after treatment (meets approved discharge limits). Additionally, at other facilities, LLNL treated 540 cubic meters of LLW. No TRU waste was treated in 2002.

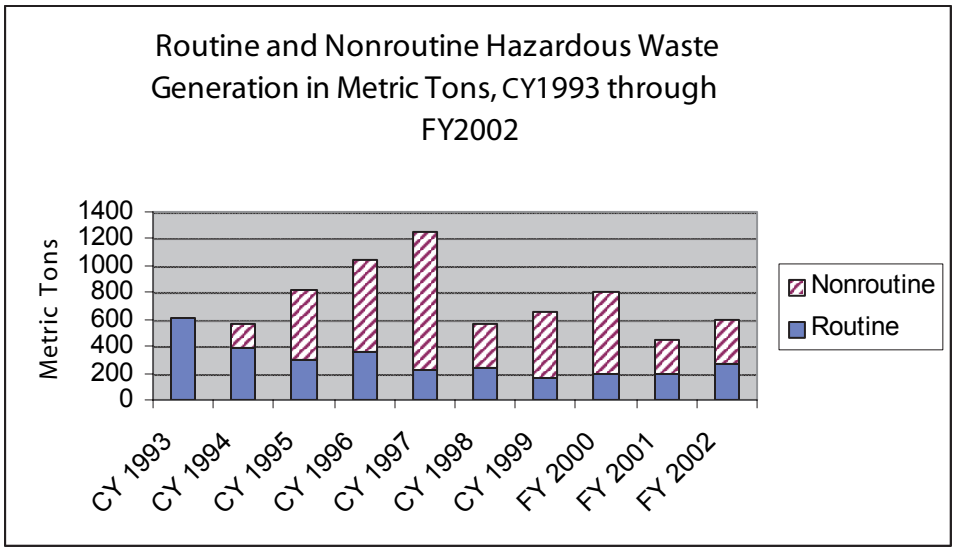
Hazardous Waste

Hazardous waste refers specifically to nonradioactive waste, including RCRA chemical and explosives waste, California toxic hazardous waste, biohazardous (medical) waste, and TSCA waste (primarily asbestos and PCBs). Almost all buildings at LLNL generate hazardous wastes, ranging from common household items such as fluorescent light bulbs, batteries, and lead-based paint to solvents, metals, cyanides, toxic organics, pesticides, asbestos, and PCBs.

RCRA permits onsite management of hazardous waste at the point of generation or in designated waste accumulation areas and permits storage in permitted storage facilities. There are regulatory restrictions on the length of time that waste may be stored onsite, and waste must be stored in accordance with all applicable regulations. LLNL maintains the capability to store and treat certain hazardous wastes onsite. LLNL treats explosive wastes at Site 300. Hazardous wastes are shipped through licensed commercial transporters to various permitted treatment, storage, and disposal facilities offsite. Hazardous waste management facilities are listed in Table B.1.1–2.

Historic and Current Hazardous Waste Generation

The hazardous waste generated at LLNL is predominantly chemical laboratory trash generated from experiments, testing, other R&D activities, and infrastructure fabrication and maintenance. Figure B.4.15.2–3 illustrates the quantities of routine and nonroutine hazardous waste generated for all operations from CY1993 through FY2002. In 2000, LLNL's reporting cycle and quantities changed from calendar year to fiscal year and tons to metric tons. In FY2001 and FY2002, LLNL generated 460 and 600 metric tons of hazardous waste, respectively (DOE 2002s).



Source: DOE 2002s.

FIGURE B.4.15.2–3.—*Routine and Nonroutine Hazardous Waste Generation in Metric Tons*

All hazardous waste is managed within appropriate time limits and quantity limits. No backlogged inventory of hazardous waste exists at LLNL (for discussion regarding legacy mixed wastes see mixed waste section). LLNL maintains the capability to treat hazardous wastes onsite. In 2002, LLNL treated 140 cubic meters of hazardous waste.

Explosive Waste

The explosive waste generated at Site 300 ranges from high explosives and analytical chemicals to wastewater contaminated with explosives. In 2002, 6,000 pounds of explosive waste were stored at the EWSF. Waste high explosives are treated at the EWTF, a facility used for thermal treatment of these wastes. In 2002, the EWTF treated 2,700 pounds. The treatment process involved 64 burns and 19 detonations.

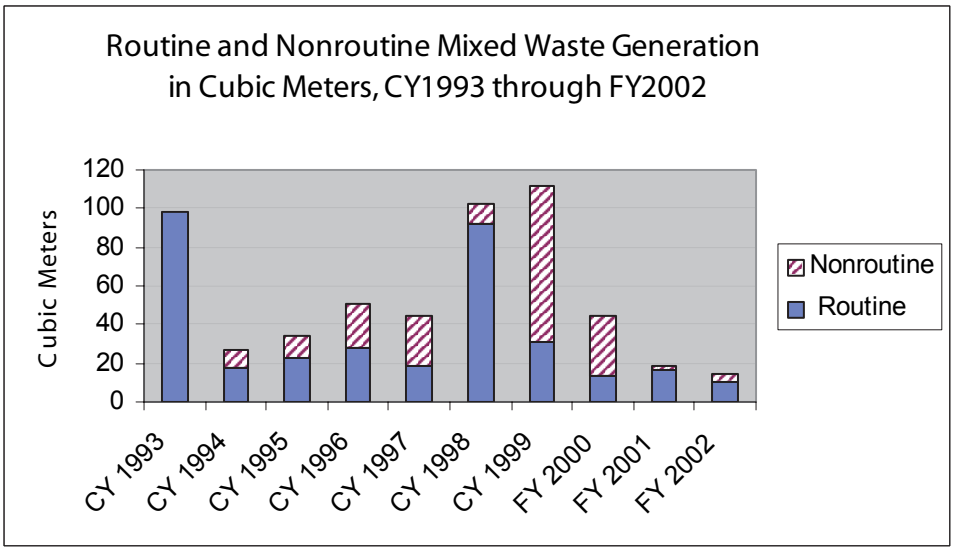
Mixed Wastes

Mixed waste generated at LLNL includes MLLW, TSCA-mixed, and mixed TRU (see Table B.4.15.2–3). MLLW and mixed TRU are produced primarily in laboratory experiments and component tests. Figure B.4.15.2–4 illustrates the quantities of mixed waste generated from CY1993 through FY2002. TSCA-mixed wastes are produced primarily during D&D- and environmental restoration-related activities.

TABLE B.4.15.2–3.— ***Mixed Waste Generated in FY2001 and FY2002 (in cubic meters)***

Radioactive Waste Generated	2001	2002
MLLW	23	63
Mixed TRU waste	0	0
Mixed TSCA	0	0
Mixed Total	23	65

Source: DOE 2002s.
MLLW = mixed low-level waste; TRU = transuranic; TSCA = *Toxic Substances Control Act*.



Source: DOE 2002s.

FIGURE B.4.15.2–4.—*Routine and Nonroutine Mixed Waste Generation in Cubic Meters*

LLNL does not maintain the capability to dispose of solid mixed wastes onsite. LLNL treats liquid mixed wastes at the Treatment Area 514 Tank Farm (LLNL 2002p) and DWTF. LLNL treats and disposes of MLLW offsite under the Federal Facility Compliance Order issued jointly to the University of California and the DOE (LLNL 2002cc). LLNL is continuing to work with the DOE to maintain compliance with the *Federal Facilities Compliance Act* Site Treatment Plan (STP) for LLNL that was signed in February 1997. All milestones for 2001 were completed on time. Reports and certification letters were submitted to the DOE as required. An agreement was reached with the DTSC to extend all FY2002 and FY2003 milestones to allow LLNL to concentrate resources on characterizing and disposing of TRU waste. LLNL continued to pursue the use of commercial treatment and disposal facilities that are permitted to accept mixed waste.

These facilities provide LLNL greater flexibility in pursuing the goals and milestones set forth in the STP.

Mixed legacy waste is considered to be waste material in storage pending disposal. LLNL is in the process of disposing of this waste as treatment and disposal capacity becomes available. For the most part, mixed legacy waste is land disposal restricted. As of mid-2003, total MLLW and mixed TRU waste inventory was 530 cubic meters. Table B.4.15.2–4 provides specific radioactive waste quantities by type.

LLNL maintains the capability to treat mixed wastes onsite. In 2002, Treatment Area 514 treated 140 cubic meters of MLLW, including 38 cubic meters sewered after treatment (meets approved discharge limits). Additionally, at other facilities, LLNL treated 43 cubic meters of MLLW. No mixed TRU waste was treated in 2002.

TABLE B.4.15.2–4.—*Mixed Waste Quantities in Storage (FY2002) by Type at LLNL RHWM Facilities*

Waste Type	Quantity in Cubic Meters
MLLW	510
TRU mixed waste	17
Total inventory[a]	530

Source: LLNL 2003v.
[a] Radioactive waste inventory from Buildings 514, 612, 693, 233 CSU, and 883.
MLLW = mixed low-level waste; TRU = transuranic.

Biohazardous Wastes

Biohazardous wastes include bioagents and medical wastes. Bioagents include toxins, toxin fragments, and biohazardous materials.

The Livermore Site is considered a large-quantity generator because 200 pounds of medical waste is normally generated in a calendar month in a 12-month period. Medical wastes consist of biohazardous waste and sharps (e.g., needles, blades, and glass slides) waste. Medical wastes generated at LLNL are managed as a separate waste stream in accordance with the *California Health and Safety Code*, Division 20, Chapter 6.1. In 2000 and 2001, several hundred kilograms of biohazardous waste were generated, treated, and disposed of at an approved offsite facility.

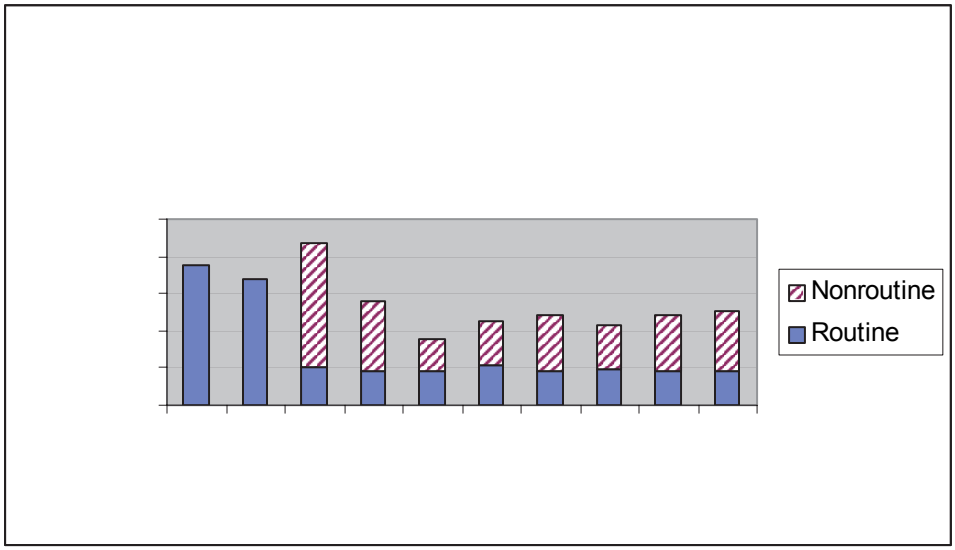
Other biohazardous wastes generated (including bioagents and toxins) are carefully segregated and disposed of based on hazards. For example, radioactive biohazardous or biological waste is disposed of as radioactively contaminated waste at an approved offsite facility.

LLNL's Site 300 is considered a small-quantity generator of medical waste, which means that less than 200 pounds of medical waste is generated in a calendar month in a 12-month period. Therefore, Site 300 is not subject to medical waste generator and treatment permit fees and is not subject to annual inspections by San Joaquin County. Site 300 does, however, submit a minimal annual fee for a Limited Quantity Hauling Exemption, which allows registered LLNL haulers to transport medical waste generated at Site 300 to the Livermore Site for waste consolidation prior to offsite shipment.

Other Wastes

Sanitary Solid Waste

Routine sanitary solid waste consists predominantly of office and laboratory nonhazardous trash. Nonroutine sanitary solid waste consists predominately of nonhazardous building debris generated from major construction and D&D activities. All solid waste from the Livermore Site is currently disposed of at the Altamont Landfill in Livermore, California or diverted for recycling (see Appendix O). The Altamont Landfill has a remaining capacity of approximately 15 million cubic yards (over 10 years) (CIWMB 2002). There are two active landfills in San Joaquin County that have over 10 years of capacity. Figure B.4.15.2–5 summarizes historic sanitary solid waste quantities generated onsite from CY1993 through FY2002 showing portions of routine and nonroutine generated each year with the exception of CY1993 and CY1994. In FY2001 and FY2002, LLNL generated 1,900 and 1,800 metric tons of routine sanitary waste each year and 3,000 and 3,300 metric tons of nonroutine sanitary waste, respectively (DOE 2002s).



Source: DOE 2002s.
[a] Nonroutine quantities included in routine total for CY1993 and CY1994.

FIGURE B.4.15.2–5.—*Sanitary Waste Generation in Metric Tons*

Environmental Restoration Wastes

Environmental investigations and cleanup activities at LLNL began in 1981. The Livermore Site became a CERCLA site in 1987 when it was placed on the National Priorities List (NPL). Site

300 was placed on the NPL in 1990. LLNL continues to perform environmental restoration activities in accordance with CERCLA provisions and approved plans.

Current activities at the Livermore Site include 29 treatment facilities: 27 are groundwater treatment facilities and 2 are vapor treatment facilities (VTFs). A total of 84 groundwater extraction wells operated at 27 separate locations at an average flow rate of 2,540 liters per minute. A total of two vapor extraction wells operated at two separate locations at an average flow rate of 670 cubic meters per minute. Table B.4.15.2–5 presents the treatment area and VOCs removed from groundwater and soil at the Livermore Site.

TABLE B.4.15.2–5.—*Volatile Organic Compounds Removed from Groundwater and Soil at the Livermore Site*

		2002		Cumulative Total	
Treatment Area	**Startup Date**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**
TFA	1989	251.4	5.7	3,658	154
TFB	1990	130.2	6.1	787	54.2
TFC	1993	107.9	7.1	595	53.9
TFD	1994	281.3	68.4	1,505	500
TFE	1996	110.5	17.5	544	139
TFG	1996	12.1	0.7	70.4	3.7
TF406	1996	40.5	1.0	211	7.7
TF518	1998	4.9	0.6	37.1	4.3
TF5475	1998	0.72	0.7	2.3	4.8
		Soil Vapor Treated (thousand cubic meters)	**VOCs Removed (kilograms)**	**Soil Vapor Treated (thousand cubic meters)**	**VOCs Removed (kilograms)**
VTF518	1995	0	0	425	153
VTF5475	1999	143.5	37.7	659	306

Source: LLNL 2003l.
VOCs = volatile organic compounds.

Table B.4.15.2–6 summarizes FY2002 and cumulative totals of volumes and masses of contaminants removed from groundwater and soil vapor at Site 300.

Other environmental restoration wastes (soil, personal protection equipment, samples) are rolled into radioactive and hazardous waste categories previously discussed.

Industrial Wastewater

Industrial wastewater is water that contains constituents at concentrations too high to allow discharge to the sanitary sewer, but does not meet the criteria to be designated as hazardous waste. Several thousand gallons of wastewater are held pending analysis each day. Only a small portion would be considered industrial wastewater (<1 percent).

At Site 300, Buildings 806, 807, 809, 825, and 826 process nonhazardous wastewater through several steps (e.g., filters) into Class II surface impoundments (LLNL 2002cc).

Sanitary (Domestic) Wastewater

Liquid effluents with contaminants below limits specified by the city of Livermore are released to the city of Livermore sewer system. In FY2002, LLNL generated approximately 240,000 gallons per day (LLNL 2003l). The sewer system capacity is approximately 1,685,000 gallons per day (LLNL 2002dm). In FY2001 and FY2002, Site 300 (GSA) generated approximately 2,100 gallons per day (LLNL 2002cc). Site 300 remote facilities use septic systems.

TABLE B.4.15.2–6.—*Volatile Organic Compounds Removed from Groundwater and Soil Vapor at Site 300*

		2002		Cumulative Total	
Treatment Area	**Startup Date**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**
GSA-Eastern GWTF	1991	78.7	0.17	806.6	6.19
GSA-Central GWTF	1993	4.19	0.59	29.16	10.66
Building 834	1995	0.11	0.81	0.93	31.84
High Explosives Process Area	1999	4.5	0.012	10.5	0.058
Building 832	1999	1.90	0.12	5.68	0.44
Building 854	1999	3.67	0.78	12.25	6.14
Pit 6	1998	N/A	N/A	0.268	0.0014
		Soil Vapor Treated (thousand cubic meters)	**VOCs Removed (kilograms)**	**Soil Vapor Treated (thousand cubic meters)**	**VOCs Removed (kilograms)**
GSA-Central	1994	293.58	1.54	1987.18	66.16
Building 834	1998	406.18	5.19	1657.56	108.26
Building 832	1999	96.2	0.28	282.5	1.39

Source: LLNL 2003l.
GSA = General Services Area; GWTF = groundwater treatment facility; N/A = not applicable; VOCs = volatile organic compounds.

B.4.16 Utilities and Energy

Utilities and energy systems at LLNL consist of water, sanitary sewer systems, electrical transmission and distribution, and communication systems that support operations at the site.

The water supply system currently provides 1.36 million gallons per day of water for fire protection, industrial support of LLNL's research programs, and sanitary use (Table B.4.16–1). The Livermore Site is supplied by the San Francisco Water District through the Hetch Hetchy Aqueduct. When needed, water is also supplied by the Alameda County Flood Control and Water Conservation District. LLNL also maintains the drinking water distribution system at SNL/CA.

The sewer system discharged approximately 300,000 gallons per day of industrial and domestic wastewater (Table B.4.16–1). The site operates a wastewater management control system whereby potentially contaminated laboratory wastewater is routed to retention tanks for analysis and proper disposal. The system provides an additional mechanism for preventing any release of regulated materials from reaching offsite.

All utility and energy systems are currently operating within existing capacity. The Safety and Environmental Protection Directorate uses less than 5 percent of the current usage presented in Table B.4.16–1 (TtNUS 2003).

TABLE B.4.16–1.—*LLNL Utility and Energy Systems*[a]

Utility System	Total LLNL Usage	RHWM	Current Capacity
5ESS telecomm. switch	18,973 (voice lines)	505	20,384
Telecomm. dist. system:			
Copper trunk cables (B256 to 13 nodes)	20,330 (pairs)	540	46,800
Fiber trunk cables	1,468	39	2,368
Copper distribution (Nodes to buildings)	96,950	2,580	115,158
Network speed to desktop	10 Mbps	10 Mbps	10 Mbps
Electricity	57 MW	1.5 MW	125 MW
Natural gas	12,900 therms/day	554 therms/day	24,500 therms/day
Domestic water	1.2M gal/day	0.04 gal/day	2.88M gal/day
Low conductivity cooling water	36.5 MW	1 MW	70.2 MW
Demineralized water	27,700 gal/day	N/A	50,400 gal/day
Sanitary sewer	216,400 gal/day	8,000 gal/day	1,685,000 gal/day
Compressed air	2,400 SCFM	72 SCFM	4,090 SCFM

Source: LLNL 2002dm.
[a] For the purpose of simplicity, the most recent published site comprehensive plan was used as the primary reference.
gal/day = gallons per day; Mbps = megabits per second; MW = megawatts; N/A = not applicable; SCFM = standard cubic feet per minute.

B.4.17 Worker Safety and Human Health

This section summarizes the occupational protection programs responsible for ensuring that hazardous material management and waste management activities are performed in a manner protective of ES&H relative to the permitted waste management units.

B.4.17.1 *Worker Health and Safety*

LLNL employs ISMS to control hazards associated with site operations, including hazards related to the management and use of hazardous materials. The ISMS process includes project planning, hazard assessment, identification and feedback, and continuous improvement planning. LLNL also follows specific management processes to ensure that adequate security and accountability requirements are met for radioactive and high-hazard materials. Inventory controls are implemented to ensure that material quantities are maintained at mission-essential levels.

Hazardous materials used at LLNL include radioactive material, chemicals, and explosive materials. Hazardous materials are managed at LLNL in a way that ensures cradle-to-grave accountability. The inventory systems for radioactive, chemical, and explosive materials provide the tracking mechanisms for inventory and waste control. Materials remain in appropriate storage areas until they are identified as waste and transferred to the waste management organization for disposal.

Radioactive Material

LLNL maintains an inventory of radioactive material used in laboratory research and radiation monitoring activities. All radioactive material used by LLNL is obtained from offsite vendors.

Individual sources at LLNL generally have small quantities of radioactive material and most are sealed. Management of radioactive material at LLNL incorporates the principle of as low as reasonably achievable (ALARA). Specific activities at LLNL associated with radioactive materials are conducted in accordance with the LLNL ES&H Manual (LLNL 2000i), which incorporates the requirements of 10 CFR Part 835, *Occupational Radiation Protection*, and addresses all activities associated with radioactive materials management, including personnel training, inventory control and monitoring, safety assessments, and handling.

LLNL worker doses have typically been well below DOE worker exposure limits. LLNL set administrative exposure guidelines at a fraction of the exposure limits to help enforce doses that are ALARA. Table B.4.17.1–1 presents average individual doses and LLNL collective doses from 1997 through 2001.

TABLE B.4.17.1–1.—*LLNL Radiation Exposure Data (1997 through 2001)*

Year	Collective Dose (TEDE) (person-rem)	Number with Measurable Dose	Average Measurable Dose (TEDE) (rem)
1997	22.1	191	0.116
1998	6.9	107	0.064
1999	14.9	137	0.109
2000	12.7	145	0.086
2001	18.4	153	0.120
Average	17.3	173	0.1
Estimate RHWM worker	0.52	5	0.003

Source: DOE 2001c.
Note: Data for individual divisions within LLNL (for example ES&H Security Directorate) are NR. Organization numbers for LLNL personnel sometimes change due to work changes or corporate reorganizations. During any 3-month period, monitored personnel may change organizations one or more times.
rem = roentgen equivalent-man; RHWM = radioactive and hazardous waste management; TEDE = Total Effective Dose Equivalent.

Chemical Materials

Specific activities at LLNL associated with chemical materials are conducted in accordance with the LLNL ES&H Manual. The manual provides requirements for the proper management of hazardous materials, responsible organizations, and inventory control.

LLNL maintains a centralized chemical inventory database, ChemTrack, for tracking hazardous chemicals in primary containers (primary means those containers shipped by the manufacturer). The ChemTrack system requires bar coding of chemical containers as they enter LLNL to allow container tracking and access to online chemical inventory data. The bar coded chemical containers are tracked to provide location and usage information from arrival at LLNL through disposal of the container by the waste management program. The LLNL links the bar-coded chemical containers to a location and a chemical custodian (may be more than one person), the Material Safety Data Sheets (MSDS) (if available), related chemical properties, hazard data, and regulatory information.

Explosive Materials

Site 300 uses explosives in various R&D and test applications. Explosive quantities used per activity range from milligrams to several kilograms. Overall, the quantities of explosive material maintained onsite are restricted by the approved explosive capacity of various storage areas. The HEAF located at the Livermore Site uses explosives in various activities in small quantities.

An explosives safety program is used to manage explosives at LLNL. It provides guidance for evaluating and safely conducting explosives operations. The LLNL explosives safety committee provides continual review, interpretation, and necessary revision to the explosives safety program. As part of the explosive material management strategy, LLNL uses an explosives inventory system to track and manage explosive inventories. The explosives inventory system database maintains information on material composition, characteristics, and shipping requirements; life cycle cost information; plan of use; security and hazard classifications; and compatibility codes. When an explosive material is entered into the explosives inventory system database upon delivery or receipt, the system performs a safety check to ensure that the intended storage location can accept the type and quantity of material received. The explosives inventory system database will flag any storage capacity overages and incompatible explosive items.

B.4.17.2 *Occupational Health and Safety*

A worker protection program is in place at LLNL to protect the health of all workers. To prevent occupational illnesses and injuries and to preserve the health of all workers involved in site-related activities (construction and operations), DOE-approved health and safety programs have been implemented. Table B.4.17.2–1 presents LLNL injury rates over a 3-year period from 1999 through 2001, in terms of total reportable cases rate, lost work day cases rate, and lost work days rate. The total reportable case value includes work-related death, illness, or injury that resulted in loss of consciousness, restriction from work or motion, or transfer to another job or that required medical treatment beyond first aid. The data for lost work days represent the number of workdays beyond the day of injury or onset of illness that the employee was away from work or limited to restricted work activity because of an occupational injury or illness.

As shown in Table B.4.17.2–1, these health and safety programs have resulted in lower incidences of injury and illness than those that occur in the general industry, construction, and manufacturing workforces.

TABLE B.4.17.2–1.— ***Injury and Illness Data (1999 through 2001) Based on 200,000 Work Hours (100 workers)***[a]

Calendar Year	Total Reportable Cases Rate	Lost Work Day Cases Rate	Lost Work Days Rate
1999	3.8 (6.3)[a]	1.1 (3.1)[a]	13.7 (1.9)[a]
2000	3.5 (6.5)[a]	0.9 (3.3)[a]	23.1 (2.0)[a]
2001[b]	3.7	1.1	14.1
3-Year Average	3.7 (6.5)[c]	1.0 (3.2)[c]	17.0 (2.0)[c]

Source: DOE 2002l.
[a] State of California injury and illness data is for all industries including state and local government are given in parentheses.
[b] State of California injury and illness data is for 2001 were not available at the time of the Draft LLNL SW/SPEIS.
[c] Three-year average for State of California data covers 1998 through 2000 timeframe.

B.4.17.3 *Human Health*

LLNL operates under several RCRA Part B permits and must comply with Title 22 of the *California Code of Regulations*, Article 66264.600. Several health risk assessments (HRA) were conducted, pursuant to 22 CCR 66264.601(c). For completeness, LLNL included all permitted waste facility operations in these HRAs, entitled *Health Risk Assessment for Hazardous and Mixed Waste Management Units at LLNL* (LLNL 1997q, LLNL 2003r). Specifically, the HRAs addressed those facilities that can produce atmospheric emissions and that have potential health effects. The RCRA Part B permit includes detailed descriptions of the waste generated at LLNL and the existing waste management units.

The HRAs were prepared in accordance with procedures and guidelines set forth by the DTSC and the BAAQMD. They addressed the risk associated with both the hazardous and radioactive properties of chemicals handled at LLNL's permitted waste management units. By following these procedures, the HRAs presented a health-conservative analysis of a hypothetical MEI potentially receiving a reasonable maximum exposure. The HRAs were developed using modeling of throughput capacities for the LLNL waste management units that reflected maximum annual quantities, which were approximately five times the normal quantities.

Potential carcinogenic risks and noncarcinogenic hazards resulting from the emission of the waste chemicals of concern were characterized largely based on the California Environmental Protection Agency's *Preliminary Endangerment Assessment Guidance Manual* and *Air Toxics "Hot Spots" Program Risk Assessment Guidelines* (California EPA 1994, 2002). The contribution to carcinogenic risk from emissions of radionuclides to air was based on NESHAP dose calculations required by Federal regulation. In all cases, risk and hazard were evaluated at the maximum anticipated operating levels, so that the risk and hazard estimates represented upper-bound values. The contribution to risk from emissions of radionuclides to air was obtained by multiplying the NESHAP calculated dose by the International Commission on Radiological Protection risk factor of 0.05 (lifetime excess cancer mortality risk) per Sievert. The HRAs concluded that the combined excess, offsite cancer risk from the existing RHWM facility radioactive and nonradioactive materials is less than 1×10^{-6}, using the highest calculated risk values from each type of material (LLNL 2000aa, 2003r).

In summary, the HRAs found that the risk and the hazard due to the continued operation of the existing facilities, even at maximum throughput conditions, would be below levels of concern described in the regulatory literature. With increased use, DWTF will treat the same waste streams that are treated in the existing facilities; however, DWTF will have improved air emissions control equipment and will treat some additional new waste streams. The DOE has assessed the environmental impacts associated with the construction and operation of the DWTF in an environmental assessment (DOE/EA-1150) (LLNL 1996c). Based on this assessment, the DOE issued a Finding of No Significant Impact on June 12, 1996. The latest HRA (LLNL 2003r) was prepared in support of the revised permit application, following a revised protocol approved by the DTSC and BAAQMD. The scope of the latest HRA addressed the configuration of existing facilities and full operation of the DWTF.

B.5 ENVIRONMENTAL CONSEQUENCES

This section provides information on the methods of analysis applied in this appendix and the results of analyses for LLNL waste management facilities. The appendix begins with an introduction and a summary of the impact assessment methodologies that have been applied. It continues with descriptions of the impacts of the No Action, Proposed Action, and the Reduced Operation Alternatives. For each alternative, impacts are presented by resource area (for example, infrastructure, land use, geology, and soils) or topic area (for example, waste generation, transportation, environmental justice).

Where possible, impacts of the No Action Alternative, Proposed Action, and Reduced Operation Alternative, the analyses use estimates of impacts with specific parameters. However, in certain resource areas a conservative estimate of possible impacts of the alternative, were indirectly related to estimates of impacts based on a projected increase or decrease of a given parameter (for example, relating biological resource impacts to changes in square footage).